"THE ENGINEER," MARCH 27, 1931.

With METALLURGICAL SUPPLEMENT.

The Engineer.

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The Engineer

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PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for :—
334 STEEL TYRES for CARRIAGES and WAGONS.
Tenders due 30th April, Twelve Noon, at Calcutta.
Forms of Tender available from the above at a fee of 5s., which will not be returned. 6723

Civil Service Commission.
FORTHCOMING EXAMINATION, JUNIOR TECHNICAL EXAMINER (Male), FORMERLY KNOWN AS DRAUGHTSMAN, in the Lands Branch of the War Department, age 18-22, with extension in certain cases.
Regulations and particulars, together with the forms on which applications must be made, will be sent in response to requests (preferably by postcard), addressed to the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, GIVING THE TITLE OF THE SITUATION. The latest date for the receipt of application forms is 16th April, 1931. 6638

Crown Agents for the Colonies.
COLONIAL GOVERNMENT APPOINTMENTS.
APPLICATIONS from qualified candidates are INVITED for the following POSTS :—

M/2666.—CIVIL ENGINEER REQUIRED by the GOVERNMENT of NORTHERN RHODESIA for a tour of 20 to 30 months' service, for an investigation into problems of water supply and irrigation in the Protectorate. Salary £1000 a year, free quarters and passages. Liberal leave on full salary. Candidates, preferably single, must be qualified and Chartered Civil Engineers, experienced in Water Supply, Water Power and Irrigation, and capable of carrying out their own surveys.

M/2667.—TECHNICAL ASSISTANT to a CIVIL ENGINEER, for an investigation of problems of water supply and irrigation, REQUIRED by the GOVERNMENT of NORTHERN RHODESIA for a tour of 20 to 30 months' service. Salary £500 a year. Free quarters and passages. Liberal leave on full salary. Candidates, under 35, preferably single, must be good draughtsmen, possess a knowledge of Hydraulic Data, Calculations and Design, and be capable of assisting the Civil Engineer both in the office and in the field.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, and mentioning this paper, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made. 6740

Ministry of Transport.
APPLICATIONS are INVITED from qualified Mechanical and Automobile Engineers for the following Full-time Non-pensionable APPOINTMENTS in the Headquarters' Offices of the Ministry in Whitehall :—
ONE SENIOR ENGINEER on range of pay £600-700 inclusive.
TWO ENGINEERS on range of pay £400-500 inclusive.
TWO ASSISTANT ENGINEERS on range of pay £250-400 inclusive.
Normally candidates will commence at the minimum rate of pay. Travelling, &c., expenses on the usual Civil Service Scale are payable in addition.
The duties of the appointments will be concerned with the examination and certification of the design, construction, and equipment of public service vehicles, and only candidates who have completed a recognised course of theoretical and technical training as mechanical and automobile engineers and with practical experience will be considered. For one post on each of the two ranges £400-500 and £250-400 specialised knowledge of body construction is necessary.
Applications, which should specify the appointment sought and contain full particulars of age, education, technical training and experience, should be addressed to the ESTABLISHMENT OFFICER, Ministry of Transport, Whitehall-gardens, S.W. 1, not later than the 9th April. 6730

BOILER.
The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 17th April, 1931, for SUPPLY and ERECTION of a VERTICAL STEAM BOILER, &c., at H.M. Stationery Office, Harrow.
Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 6718

City of Nottingham.
BROXTOWE-LANE WIDENING.
BRIDGE CARRYING THE BABBINGTON COAL COMPANY'S MINERAL RAILWAY.
CONTRACT NO. 1.
TO CONTRACTORS.
The Improvement Committee is prepared to receive TENDERS for the RECONSTRUCTION of the abovementioned BRIDGE. The new work consists of Concrete and Brick Abutments and Wing Walls.
Drawings may be seen and copies of the general conditions of contract, specification, bill of quantities, and form of Tender may be obtained on and after the 30th instant on application to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of Two Pounds, which will be returned on receipt of a bona fide Tender.
Sealed Tenders are to be delivered to the undersigned, in the official envelope provided, not later than 6 p.m. on Tuesday, 14th April, 1931.
The lowest or any Tender will not necessarily be accepted, and Tenders will only be accepted from firms who conform to the conditions of the contract as regards paying the local standard rate of wages, &c., and to the working rules of the Nottingham district.
By Order,
W. J. BOARD,
Town Clerk.
Guildhall, Nottingham,
25th March, 1931. 6741

PUBLIC NOTICES

City of Nottingham.
BROXTOWE-LANE WIDENING.
BRIDGE CARRYING THE BABBINGTON COAL COMPANY'S MINERAL RAILWAY.
CONTRACT No. 2.
TO STRUCTURAL ENGINEERS.
The Improvement Committee is prepared to receive TENDERS for about 60 TONS of STEEL WORK in Two-plate Girders, 80ft. 6in. long by 6ft. 6in. deep, with Intermediate Trough Flooring, Bearing Plates, etc., required in the Reconstruction of the above Bridge. The removal of the existing structure will be carried out under a separate contract.
Drawings may be seen and copies of the general conditions of contract, specification, bill of quantities and form of Tender may be obtained on application to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of £2, which will be returned on receipt of a bona fide Tender.
Sealed Tenders are to be delivered to the undersigned in the official envelope provided not later than 6 p.m. on Tuesday, 14th April, 1931.
The lowest or any Tender will not necessarily be accepted, and Tenders will only be accepted from firms who conform to the conditions of the contract as regards paying the local standard rate of wages, etc., and to the working rules of the Nottingham District.
By Order,
W. J. BOARD,
Town Clerk.
Guildhall, Nottingham,
25th March, 1931. 6742

PUBLIC NOTICES

County Borough of Warrington.
The Council of the County Borough of Warrington is prepared to receive TENDERS for the ERECTION of a :—
NEW BRIDGE OVER THE RIVER MERSEY, NEAR MANOR LOCK, WARRINGTON.
The work comprises a 60ft. wide Bridge on Two Arches, each of 86ft. span, constructed of Reinforced Concrete with Stone Facing, together with Abutments, Pier, Approaches, and other Works.
Drawings are prepared, and can be seen on and after March 30th, at the office of the Engineer for the work, Mr. H. W. FitzSimons, B.Sc., M. Inst. C.E., 39, Victoria-street, Westminster, S.W. 1. Copies of the specification, bills of quantities, and form of Tender, are to be obtained from the Engineer's Office on payment of £3 3s., which sum will be returned upon the receipt of a bona fide Tender, and the return of all documents.
Tenders, on the prescribed form, and in the accompanying envelope, are to be sent to the undersigned not later than 12 o'clock Noon on Saturday, the 18th day of April, 1931, and endorsed "Tender for Bridge near Manor Lock."
The Corporation do not undertake to accept the lowest or any Tender.
A. T. HALLAWAY,
Town Clerk.
Town Clerk's Office,
Town Hall, Warrington,
25th day of March, 1931. 6727

EASTER HOLIDAYS.

All Advertisements intended for the Classified Advertisement Section of April 3rd issue must reach this office not later than first post Wednesday, April 1st.

28, ESSEX STREET, W.C. 2

PUBLIC NOTICES

The Manchester Steam Users' Association.
The ANNUAL GENERAL MEETING of the MEMBERS was held in the Board Room of the Association, at their Offices, 20, Quay-street, Deansgate, Manchester, on Tuesday, March 24th, HAROLD LEE, Esq., J.P., Manchester (President), in the chair, when the following resolutions were adopted :—
Moved by the Chairman, seconded by J. S. Addison, Esq., London, and resolved :—
"That the Report of the Committee of Management to the Subscribers, together with the Financial Statement for the year 1930, be and is hereby approved and adopted."
Moved by —. Bolas, Esq. (Messrs. Nasmyth, Wilson and Co., Ltd., Patricroft), seconded by T. Hutchinson, Esq. (Fine Cotton Spinners' and Doublers' Association, Ltd., Manchester), and resolved :—
"That the thanks of the Association are due and are hereby presented to the Committee of Management for their past services, and that the following gentlemen be elected the Committee for the ensuing year, with power to add to their number :—
COMMITTEE OF MANAGEMENT.
Harold Lee, Esq., J.P., Manchester.
Jas. Stanley Addison, Esq., London.
J. T. Browne, Esq., Walkden.
Charles W. Crossley, Esq., J.P., Halifax.
G. Lennard Bolden, Esq., Manchester.
R. C. Macdonald, Esq., M.I. Mech. E., &c., London."
Moved by —. Lathom, Esq. (Messrs. Richard Evans and Co., Ltd., Haydock), seconded by W. A. Wordley, Esq. (Bradford Dyers' Association, Ltd., Bradford), and resolved :—
"That Messrs. F. W. Popplewell and Son, Chartered Accountants, Manchester, be appointed Auditors of the Association's accounts for the year 1931."
JAMES PARR,
Secretary.
20, Quay-street, Deansgate, Manchester,
March 25th, 1931. 6744

AN APOLOGY.

MESSRS. MARRYAT AND SCOTT, LTD., very much regret that in the issue of their House Journal, "The Engineering Gazette," for Saturday, the 14th March, 1931, it was stated that Messrs. Albion T. Snell and Partners, the Consulting Engineers to Olympia, Ltd., had overlooked, or not considered the difficulty which would arise in the case of a fire at the Empire Hall.

The matter of providing a method of opening the upper windows in case of fire (to which the statement referred) was not overlooked, and was provided for as part of the Architect's design.

We desire to apologise to Messrs. Albion T. Snell and Partners, and to express our sincere regrets for the statement which appeared. 6705

The County of London Electric Supply Co., Ltd.
BARKING POWER STATION EXTENSIONS, 1930.
TENDER FOR THE SUPPLY OF PIPING EQUIPMENT.
The County of London Electric Supply Company, Limited, are prepared to receive TENDERS for the SUPPLY and ERECTION of the necessary PIPING EQUIPMENT in connection with extensions to the Power Station at Barking.
Specifications may be obtained by manufacturers of piping equipment from the offices of the Company by application on or after Wednesday, 1st April, 1931, and on payment of a fee of £5 5s. for the first copy and £2 2s. for every subsequent copy. Sums paid for any number of copies up to three will be refunded on receipt of a bona fide Tender.
Sealed Tenders, endorsed "Tender for Piping Equipment," must be delivered, addressed to the CHAIRMAN and MANAGING DIRECTOR, the County of London Electric Supply Co., Ltd., County House, 46/47, New Broad-street, London, E.C. 2, not later than Noon on Wednesday, 13th May, 1931.
The Company do not bind themselves to accept the lowest or any Tender. 6708

Administrative County of LONDON.
The London County Council invites APPLICATIONS for APPOINTMENT at the Anerley Residential School, S.E. 20, as non-resident HANDICRAFT INSTRUCTOR. Candidates should be fully qualified Handicraft Masters (Woodwork), capable of taking charge of the instruction of boys in school and of boys over school age who are undergoing trade training. Teaching experience essential.
Salary, Burnham Scale IV. for certificated teachers.
Apply, Education Officer (S.S.6), The County Hall, Westminster Bridge, S.E. 1, for form, to be returned by 11th April. Canvassing disqualifies.
MONTAGU H. COX,
6710 Clerk of the London County Council.

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PUBLIC NOTICES

South Indian Railway Company, Limited.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. PLATELAYERS' TOOLS.
2. V.I.R. COTTON and SILK-COVERED COPPER and GALVANISED IRON WIRE ; and
3. CARRIAGE FITTINGS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Platelayers' Tools," or as the case may be, with the name of the firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, the 10th April, 1931.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 5s. for each copy of each specification.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 5, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, Westminster, S.W. 1.
25th March, 1931. 6743

Boston Commissioners of Sewers.

DRAINAGE ENGINEER AND SURVEYOR.

APPLICATIONS are INVITED for the POSITION of ENGINEER and SURVEYOR to the Commissioners of Sewers for the Wapentakes of Kirton and Skirbeck.

Candidates must be not more than 40 years of age and a Member or Associate Member of the Inst. C.E.

Preference will be given to candidates having had experience in Fen Drainage Work or Tidal River Work.

Salary £450 a year, and an allowance of £50 for travelling expenses.

Applications must be received by me not later than 7th April, 1931.

Full particulars can be obtained from the undersigned.

A. W. GROCOCK,
Clerk of Sewers.

High-street, Boston, Lincs.,
25th March, 1931. 6728

County Borough of Preston.

RIBBLE NAVIGATION AND PRESTON DOCK UNDERTAKING.

The Corporation of Preston REQUIRE the SERVICES of a CHIEF MECHANICAL ENGINEER, to act under the direction and control of the Ribble Engineer.

The duties comprise the maintenance of the Dock Equipment (Cranes, Coal Tips, Locomotives, &c.) and of the Floating Plant (Bucket Dredgers, Sand Pumps, Hoppers, Tugs, &c.), as well as the conduct of his part of the Repair Workshops.

Candidates should have had experience in work similar to that mentioned above, and be accustomed to the inspection of new work and the surveying of dredgers and vessels let on hire.

The person appointed will be required to pass a medical examination and to contribute to the Council's Superannuation Scheme.

Salary £300 per annum.

Canvassing, either directly or indirectly, will be a disqualification.

Applications, on forms which can be obtained from the undersigned, stating age and experience, with copies of three recent testimonials (which will not be returned), to be sent to me not later than Tuesday, the 14th April, 1931.

ALFRED HOWARTH,
Town Clerk.

Town Hall, Preston.
19th March, 1931. 6706

Experienced Charge Engineer

REQUIRED by the Municipal Commissioners of Singapore for the Permanent Staff of their Electric Power Station (capacity over 20,000 kilowatts), the appointment being, in the first instance, upon a three years' Agreement.

Candidates should not be over 35 years, and preferably unmarried.

They must have had a sound technical and practical training, and must possess up-to-date experience in E.H.T. Three-phase, Generation, including Operation and Maintenance of Steam Turbines, Babcock Boilers and Modern Power Station Equipment. Knowledge of Steam Turbines is particularly important.

Candidates should possess at least a Second Engineer's B.O.T. Steam Ticket.

A minimum of two years' responsible experience in a similar capacity is essential.

Applications, from persons without the full qualifications above-mentioned, will not be considered.

Salary :—5040 dollars, 5520 dollars, 6000 dollars for the three years of the Agreement, rising thereafter (if service be continued) to a maximum of 8400 dollars per annum. The exchange value of the dollar is 2s. 4d. sterling, at which rate the salary for the first year would amount to £588. There is at present no Income Tax.

Strict medical examination.

Free passage with half salary during the voyage out.

Free partially furnished quarters, with allowance for lighting.

Liberal Provident Fund.

Eight months' leave with full pay, normally granted after four years' service.

Applications, stating whether married or single and giving age and birthplace, with details of education, training and experience generally, and referring particularly to the qualifications mentioned above, and accompanied by copies (not originals), of testimonials, to be lodged with Messrs. PEIRCE and WILLIAMS, M.M. Inst. C.E., 1, Victoria-street, London, S.W. 1, Agents to the Commissioners, not later than Thursday, 9th April.

Further particulars, if desired, can be obtained from the Agents. 6739

Metropolitan Borough of Greenwich.

APPOINTMENT OF BOROUGH ENGINEER AND SURVEYOR.

The Council of the Metropolitan Borough of Greenwich is prepared to receive APPLICATIONS for the above APPOINTMENT, at a commencing salary of £900 per annum, rising to £1000 per annum by two annual increments of £50 each, together with an allowance of £100 per annum for use of motor car in connection with the Council's business, such allowance to cover all travelling expenses within the County of London and not to be regarded as an emolument of the office. Applicants must be Members or Associate Members of the Institution of Civil Engineers.

The person appointed must have had municipal experience in an executive capacity and must devote the whole of his time to the service of the Council.

Applications must be in the handwriting of the applicants on forms to be obtained from the undersigned, which, together with copies of not more than three recent testimonials, must be sealed up and endorsed "Borough Engineer and Surveyor" and received here not later than 10 a.m. on Monday, the 20th April, 1931.

The appointment will be terminable by three months' notice in writing on either side and will be subject to the provisions of the Council's Superannuation Act, as amended. Canvassing members of the Council, either directly or indirectly, will be a disqualification.

FREDERICK J. SIMPSON,
Town Clerk.

Town Hall,
Greenwich-road, S.E. 10.
20th March, 1931. 6712

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED in London Constructional Engineers' Drawing-office, smart MAN, capable of designing Steel Work in competition. Must be quick and accurate, with good knowledge of 1909 Act and L.C.C. requirements. Only thoroughly capable man need apply. State age, experience, and salary required.—Address, P897, The Engineer Office. P897 A

"WHAT THE T.I.G.B. HAS ACHIEVED FOR ME."

Students' acknowledgments of the value of T.I.G.B. Correspondence Training appear in these columns from time to time.

"I am pleased to be able to advise you that I was successful in passing Sections B and C of the Associate Membership Examination of the Institution of Mechanical Engineers in October last. I have just received cable advice to this effect. Needless to say, I am very pleased with the result, and in this connection I hasten to thank you for the assistance you gave me throughout my course."—W. R. B., Auckland, N.Z.

"With reference to the A.M.I.E.E. course I have recently been studying for, I have to inform you that I entered for the Graduate Examination at the end of November last—although I had not quite completed the lessons—and I am pleased to state that I have passed in both Part I. and Part II."—L. N. B., Clacton-on-Sea.

"I am pleased to inform you that I have to-day received intimation from the Institution of Civil Engineers that I was a successful candidate in the recent Examinations I took in Sections B and C. I am very pleased with this result, and I am most grateful to you for the valuable assistance which has been generously given to me throughout my course of studies under your direction."—G. B. B., London.

WRITE TO DAY for "The Engineer's Guide to Success"—128 pages—containing the widest selection of engineering courses in the world, and mention the branch, post or qualification that interests you. The T.I.G.B. guarantees training until successful for the one fee.

THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN (*Founded 1917*).
76, Temple Bar House, London, E.C. 4.

SITUATIONS OPEN (continued)

WANTED AT ONCE, for Service in Iraq, First-class OIL ENGINE FITTER, with practical knowledge of Internal Combustion Marine Engines. Single man, not over 30. First agreement three years. Salary Rs. 400 per month plus allowance for messing.

Passage paid ; medical expenses and furnished quarters free.

Address, giving full details, experience and reference, P928, The Engineer Office. P928 A

WANTED, by Firm Selling Road Surfacing Plant, an ACTIVE DIRECTOR, with knowledge of Public Works, preferably having connection with County and Municipal Engineers, Road Contractors, etc., and prepared to invest from £2-£5000, as the business warrants. One qualification useless without the other.

Address, P934, The Engineer Office. P934 A

WANTED, by Firm of Engineers' Merchants, a REPRESENTATIVE for Sale of Specialities. First-class salary, expenses and commission to suitable applicant who would invest up to £1000 in debentures in business.—Address, P917, The Engineer Office. P917 A

WANTED, SUB-AGENT for Large Dock Construction. Must have good experience in this class of work.

Apply in writing, stating full details of career and experience and salary required, to SIR LINDSAY PARKINSON and CO., Ltd., Robinson-lane, Grimsby. 6719 A

AN Important OPPORTUNITY is OPEN for a Qualified EXPERT MOTOR ENGINEER to join in Promoting an urgent Practical Device for Motor Vehicles. Small capital would secure substantial interest in universal rights.—Address, P933, The Engineer Office. P933 A

ASSISTANT REQUIRED for Tube Railway Work. Must have had practice in Theodolite Surveying, Quantities, etc.—Address, P932, The Engineer Office. P932 A

ASSISTANT to Production Engineer of Comm. Vehicle Factory. Not mass production. State fullest particulars, experience, age and salary required. —Address, P940, The Engineer Office. P940 A

CHIEF MAINTENANCE ENGINEER, Age 35-40, REQUIRED for Modern Plant Manufacturing Food Products, employing approx. 2000 workers. Education B.Sc. standard.

Must have had five years' workshop experience and three years' executive experience in the installation and maintenance of equipment in similar plant. Adequate remuneration offered. Excellent prospects for right man.

Address, giving full chronological report on training and experience, also salaries earned, &c., in confidence, P930, The Engineer Office. P930 A

COMMERCIAL MANAGER REQUIRED for Important Structural Engineering Company in India. Must have good knowledge of Accounts, Financial Control of Business and able to Control Staff ; knowledge of Engineering Contracts desirable.—Reply, giving full details of education, experience, age and, date when available, to WHITEHILL, MARSE-JACKSON and CO., Chartered Accountants, 67, Broad Street-avenue, London, E.C. 2. 6679 A

ENGINEERS.—Well-known Firm of Public Works Contractors REQUIRE the SERVICES of Young, capable ASSISTANT ENGINEERS with experience in Setting Out. Also JUNIOR ENGINEERS.

State age, qualifications and salary required. Excellent prospects for right type of men.

Address, P904, The Engineer Office. P904 A

INDIA.—DEPARTMENTAL MANAGER REQUIRED for Structural and Bridge-building Department of a large Engineering Firm in India. Sound practical and theoretical knowledge, combined with ability to control staff, Drawing Office and labour, essential. Public School education, Engineering Degree. Age 25 to 30, single.—Write, with full particulars of experience and copies of any testimonials available, to ZH 342, c/o Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 6725 A

INDIA.—MECHANICAL ENGINEER, Age 25 to 30, single man, with Public School education and Engineering Degree, REQUIRED as Departmental Manager in Engineering Firm of standing in India. Applicants must have special knowledge of Machine Shop Production Methods, coupled with a first-class knowledge of Modern Foundry Practice. Drawing Office experience and control ability essential.—Write, with full particulars of experience, and copies of any testimonials available, to ZG 341, c/o Deacon's Advertising Offices, Fenchurch-avenue, E.C. 3. 6724 A

INSPECTOR and INSTRUMENT MAN for Reinforced Concrete Job near London. Previous experience similar work essential. Salary about £7 per week. Full particulars previous experience.—Address, P938, The Engineer Office. P938 A

INSPECTOR for Gauging and Checking Parts for Electric Motors. S.E. London. State experience and salary required.—Address, P927, The Engineer Office. P927 A

LUBRICATING OILS, MOTOR OILS, CUTTING OILS, &c.—Old-established FIRM, holding contracts with L.C.C., Kent County Council, &c., WISHES to GET in TOUCH with MEN able to introduce business. Liberal commission will be paid.—Address, P872, The Engineer Office. P872 A

MARINE PETROL ENGINE SALESMAN REQUIRED. Must have good selling experience. Small salary, expenses and commission, with excellent future. State age and salary required.—Address, 6720, The Engineer Office. 6720 A

METALLURGIST, Not Under 28, with Foundry and Steel Works practice, good theoretical education, preferably University Degree, interested in commercial and practical work for development work and sales activities.

Excellent prospects for energetic man.

Address, Age, education, experience, salary, &c., to "Scientific Practical," 6737, The Engineer Office. 6737 A

SITUATIONS OPEN (continued)

PRODUCTION ENGINEER, Age 28-36. Good general and technical education necessary. Must have had five years' sound workshop experience and have spent at least three years in an executive capacity specialising in the design and manufacture of Press Tools for the canning industry.

Experience in control of labour essential. Good salary and prospects offered to right man.

Address, in strict confidence, giving chronological statement of education, experience, salaries received, &c., P929, The Engineer Office. P929 A

ZEISS MEASURING INSTRUMENTS.—WANTED, SALESMAN DEMONSTRATOR of Zeiss Measuring Instruments. Preference given to applicants with practical knowledge of workshop measurement and proved sales ability.—Apply, ALFRED HERBERT, Ltd., Coventry. 6709 A

WANTED, MECHANICAL DRAUGHTSMAN for short period ; preference given to one with experience on Small Transmission Gear. Works situated on East Coast.

Address, giving full particulars and salary required, 6747, The Engineer Office. 6747 A

DRAUGHTSMAN REQUIRED. Electrical Knowledge and experience of Machine Shop Practice essential. Technical qualifications should include Senior National Certificate for Electrical or Mechanical Engineering or its equivalent.—Apply, in writing, stating age, experience and salary required, to the CHIEF ENGINEER, The Siemens and General Electric Railway Signal Co., Ltd., Central House, Kingsway, W.C. 2. 6746 A

DRAUGHTSMAN REQUIRED for Concrete Mixer Works, Tarmacadam and Asphalt Plants. Eastern Counties. Please give particulars of experience, age and salary required.—Address, 6745, The Engineer Office. 6745 A

INDIA.—REQUIRED, for Large Indian Works, thoroughly Competent RAILWAY CARRIAGE and WAGON DESIGNER DRAUGHTSMAN. Single man, age 25 to 30. Must have had good experience in large Carriage and Wagon Works on this side.—Write, with full particulars of training and experience, with copies of testimonials, to Box ZJ 343, c/o Deacon's Fenchurch-avenue, E.C. 3. 6726 A

PLANT DRAUGHTSMAN REQUIRED for Temporary post. Experience of Conveying Plant an advantage.—Write, stating age, experience and salary required, to the NATIONAL SMELTING CO., Ltd., Avonmouth. 6748 A

FOREMAN WANTED, First-class Man, to Take Charge Civil Engineering Construction, including Deep Excavations, Granite and Pile Driving.—Full particulars and copies references by letter only to BLUNDELL, 10, Premier-buildings, Waterloo-terrace, N. 1. P924 A

SITUATIONS WANTED

A SPECIALITY MACHINE TOOL REP. and DEMONSTRATOR, with extensive connection in Lancashire and Yorkshire, SEEKS ENGAGEMENT. Interview in London immediately. Highest refs. Free April.—Address, P937, The Engineer Office. P937 B

ADVERTISER, with Extensive Connection Engineers, Ironmongers, Eastern Counties, WANTS ADDITIONAL LINE. Commission basis. Own car.—Address, 6674, The Engineer Office. 6674 B

ARGENTINE.—M.I.C.E., 25 Years' Resident, Fluent Spanish, personal friend of many influential people, both British and Argentine circles, WISHES REPRESENTATION British Firms in South America.

Address, P925, The Engineer Office. P925 B

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For continuation of For Sale Advertisements see page 4.

A Seven-Day Journal

A Railway Record.

IT is interesting to note that the Great Western Railway locomotive "City of Truro," which is at present undergoing repairs at Swindon, is to be removed from active service and sent to the railway museum at York. The "City of Truro" is famous for having reached the highest speed ever officially recorded on British railways. In 1904, there was competition between three of the railway companies for the carriage of the American mails which might reach London *viâ* Holyhead, Liverpool, or Plymouth. On May 1st, a run with the mail train between Plymouth and London was accomplished in record time, and the pages of our issues during the following six weeks contain a number of articles breathing the very spirit of the enthusiasm aroused by the competition. The "City of Truro," then a new engine, drew the train from Plymouth to Bristol and at one part of the line reached a speed of 102·3 m.p.h. An even higher velocity might have been attained, but, unfortunately, some plateplayers misjudging the rate at which the train was approaching did not leave the line rapidly enough, and the speed had to be checked. But, even if this record speed had not been attained, the run would have been very notable. The "Duke of Connaught," a single-wheeler, drew the train between Bristol and London, and the total distance of 246¼ miles was covered in the astonishing time of 3 hr. 46 min. 28 sec. The "City of Truro" is a 4–4–0 type locomotive, with coupled wheels, 6ft. 8in. diameter, designed by Mr. Churchward. During 27 years of service, it has covered more than one million miles.

A Telephone Call from India.

ON Thursday, March 19th, we had the privilege of testing the wireless telephone service arranged between this country and India by the G.P.O. and the International Marine Radio Company. At the invitation of the *Times of India*, we visited the London office of that journal at Salisbury House, E.C. 4, and at 6 p.m. received a telephone call from Mr. E. J. M. Hudson, the Editor of the engineering section of the *Times of India* in Bombay. The reception in London left nothing to be desired, and, judging by the readiness with which Mr. Hudson answered questions put to him, it was equally good in India. Mr. Hudson's voice came through as strongly and distinctly as though he were speaking from any London exchange, notwithstanding that the distance between London and Bombay is 4328 statute miles. The call was made from the liner "Belgenland," in Bombay Harbour, and the incoming conversation was transmitted direct to the G.P.O. receiving station at Baldock and carried by telephone line to London, whilst the outgoing speech was conveyed by land line to the Rugby radio station, and thence direct to the liner, which has been specially equipped with wireless apparatus for a cruise round the world. The carrier power of the ship's transmitter on telephony is from 400 to 600 watts, according to the wave length, and this power can be fully modulated without distortion. The wave length range of the equipment is from 13 m. to 90 m., and we understand that on the occasion mentioned a wave length of 24 m. was used.

The Norwich Rural Electrification Scheme.

FOLLOWING the initiation of the Bedford demonstration rural electrification scheme in 1929, the Electricity Commissioners were asked by the Minister of Transport to arrange for the carrying out of similar schemes in typical rural areas in other parts of the country. In collaboration with the Corporation of Norwich, the Commissioners have prepared a scheme for a selected area forming part of the authorised area of supply of the Corporation, and particulars of the scheme are given in a memorandum just issued by the Commissioners. The area selected is centred around the small country town of Reepham, which lies about 12 miles to the north-west of the city of Norwich, and covers about 125 square miles, with a population of 14,166 inhabitants, and 3588 occupied dwellings. It is definitely rural in character and is dependent almost wholly on agriculture, the workers in that industry forming the bulk of the population. About 95 per cent. of the land is under cultivation, and the greater portion is arable. As Norwich is a "grid" point under the East England Electricity Scheme, the Corporation will be in a favourable position to furnish a supply in bulk to the area, as well as to other rural districts. The scheme involves the construction of a network of about 60 miles of three-phase and about 40 miles of single-phase overhead transmission lines, operating at 11,000 volts, which is the standard pressure adopted by the Norwich Corporation for rural supplies. Certain work has already been carried out at Reepham, Cawston and Haydon at a cost of £5000, and this work and the capital expenditure involved will be included in, and will form part of, the demonstration scheme. On the other hand, the capital expenditure on the ring main provided by the Corporation for the development of other parts of its rural area, as well as the selected area, will not form part of the capital expenditure of the demonstration scheme. The cost of the bulk supplies furnished to the demonstration area will, however, be debited with a proper share of the capital charges on, and cost of operation and upkeep of, the ring main. It is expected that the whole of the transmission and distribution systems will be constructed within two years.

Self-Help in the Coal Industry.

IN a paper on "Self-help in the Coal Industry," read before a joint meeting of the Coal Trade Luncheon Club, the Mining Association of Great Britain, the Coal Merchants' Federation, and the Institute of Fuel, at the Institution of Civil Engineers last Monday, March 23rd, Mr. R. A. Burrows, the author, put forward the plea that the industry itself should undertake the task of reform, where necessary. He said that at most collieries the sale and distribution side had come under the control of the mining and production departments, with the result that although plenty of attention had been devoted to general research on mining and safety, little interest was shown in the development of the sales side. He held the opinion that the section of the colliery industry dealing with the preparation and treatment of coal could make or mar the business, and that that section should be recognised as a separate department working in close co-operation with the sales department. After mentioning that both the gas and electrical industries had made full use of the power of publicity, the author suggested that research associations, supported by both collieries and merchants, could carry out researches in the commercial utilisation of coal, with great advantage to the industry. Particular notice should be taken of the extraction of oil from coal. Dealing with the sales side, the author said that the industry could do a great deal towards popularising coal by standardising the nomenclature of the various grades, and that much could be done to improve methods of distribution. Finally, he pointed out that the industry must not look outside for help, but must itself take steps to remedy the defects in the present system. For that purpose, the co-operation of all parties was very necessary.

Soviet Contracts.

THE announcement is made by the trade delegation of the U.S.S.R. in Great Britain that a number of orders have been placed with British firms. It is reported that the Metropolitan-Vickers Electrical Company, Ltd., is to supply electrical equipment to the value of £200,000; that Babcock and Wilcox, Ltd., have received an order for boiler plant worth £50,000; and that £73,000 worth of tin-plates will be supplied by the South Wales Tin-plate Corporation. Agreements have also been concluded with Alfred Herbert, Ltd., and the Associated British Machine Tool Makers, Ltd. The delegation is also making an attempt to secure an agreement with shipbuilding firms on the Clyde for the building of trawlers, and a deputation visited the district last week-end with that purpose in view. It will be remembered that agreement could not be reached last year, owing to the question of long-term credits, and many of the orders went to Italian firms. The U.S.S.R. anticipates a considerable increase in export and import trade next year, and desires to acquire new tonnage for the timber and oil-carrying trades, besides ships for general cargo and passengers. In the event of a satisfactory arrangement being made, it is probable that the orders will be placed with several firms in order to expedite delivery.

Railwaymen's Wages.

YESTERDAY—Wednesday, March 25th—the Society of Locomotive Engineers and Firemen, by accepting the recommendations of the Wages Board, the deliberations of which we have recorded from time to time in this journal, brought nearer the prospect of a satisfactory settlement of the wages controversy. While accepting the recommendations of the Board, however, the national delegate conference of the Society showed its dissatisfaction with the terms by approving the resolution that "This special assembly of delegates strongly resents the monstrous award of the National Wages Board which means a further worsening of the locomotive men's conditions of service, but we feel there is no practicable alternative but to accept the award." Two other unions are concerned with regard to the acceptance of the award. One of these, the Railway Clerks' Association, expressed its agreement with the terms a few days ago. The National Union of Railwaymen is expected to be announced to-day.

Port of London Traffic.

ON Thursday, March 19th, at the last meeting of the present Board of the Port of London Authority, the Chairman, Lord Ritchie of Dundee, presented an account of the progress of the Port from the time when the present Board was constituted. He gave the following figures with regard to the total net registered tonnage of vessels arriving and departing from the Port:—In 1927, 52,576,755 n.r.t.; in 1928, 55,423,681 n.r.t.; in 1929, 57,578,355 n.r.t.; and in 1930, 58,085,598 n.r.t. It would be noticed, he said, that the tonnage for 1930 represented an increase of 10·5 per cent. over that for 1927. A record was created during the week ending August 15th last year, when 1478 vessels, with a total net tonnage of 1,124,404, used the Port. The tonnage using the Port of London in 1927 and again in 1929 represented 15·9 per cent. of the total tonnage figures for all the ports of the United Kingdom. That entering and leaving the Authority's wet docks increased from 28,850,936 n.r.t. in 1927 to 33,344,028 in 1930, and that making use of the dry docks increased from 3,014,086 g.r.t. in 1927 to 3,422,888 g.r.t. in 1930, although in 1928 and 1929 the figures had been below the three million mark. In conclusion, Lord Ritchie said that the trade of the whole country was in a critical state, and that that was certain to be reflected in the trade of the Port of London. The Board had managed to maintain the position very well, but recent statistics showed a downward tendency, and although the present Board had achieved much towards reducing costs, the new Board would have to consider the possibility of taking further steps in the same direction.

The Proposed New Bridge Over the Forth.

ON Tuesday last, March 24th, an inquiry was opened at the Parliament House, Edinburgh, with regard to the provisional order for the erection of a new bridge over the Firth of Forth at Kincardine. The Commissioners were Lord Liverpool (the Chairman), Lord Polworth, Sir George Berry, and Mr. W. Brooke. After particulars had been given of the existing facilities for cross-river traffic, the principal features of the proposed new bridge were outlined. The scheme provides for a bridge having a total length of 2425ft., at an estimated cost of £369,000, of which £296,000 will be for the bridge itself. A swing span to give a clear opening of 150ft. at each side of the span is provided for. The Ministry of Transport has agreed to bear 85 per cent. of the cost, while the balance would have to be shared by the County Councils of Fife, Stirling, and Clackmannan, and the Burghs of Dunfermline and Falkirk. Some objections from the point of view of shipowners, and other questions relating to tides and river navigation, were brought forward. The Commissioners announced their approval of the preamble of the order after certain minor alterations had been made.

The Grounding of the "Montclare."

ON Saturday last, March 21st, the Canadian Pacific liner "Montclare," inward bound from Canada with 300 passengers, grounded on the Little Cumbrae Island, while proceeding up the Clyde estuary to Greenock. At the time when the vessel went ashore, about 1.30 p.m., at high water, the whole of the Firth had been fog-bound for some hours, and the ship was going dead slow, so that the contact was hardly perceptible. As the tide receded the liner took a list to port, and it was thought advisable to land the passengers on the island in the lifeboats. After a short time they re-embarked in the boats and were transferred to two waiting tugs, which had been summoned by wireless. The passengers were landed at Largs, little the worse for their unexpected experience, and proceeded to Glasgow by special train. By the aid of tugs the stern of the ship was moved into deeper water, and some twenty-four hours after the grounding she was refloated and proceeded under her own steam to Liverpool for dry-docking. It is somewhat remarkable that the spot at which the "Montclare" went ashore is but a short distance from the Little Cumbrae Lighthouse, at which the new talking beacon, described in our Journal note of January 16th, was recently installed. The apparatus, which was invented by Mr. Charles A. Stevenson, M. Inst. C.E., of Edinburgh, and his son, Mr. D. Alan Stevenson, consists of a radio gramophone, which works in conjunction with the fog signal, enabling the exact distance of the ship from the beacon to be readily obtained. No official information is at present available, and there seems to be some doubt that the wireless beacon was in operation at the time of the grounding.

A Water Speed Record.

To the American Commodore Gar Wood belongs the honour of first officially passing the 100 m.p.h. mark on the water. Last Friday, March 20th, on Indian Creek, in America, he achieved a speed of 102·155 m.p.h. in his speed boat "Miss America IX." It will be remembered that Sir Henry Segrave lost his life last year on Lake Windermere when raising the record to the level of 98·7 m.p.h., a figure which had not been exceeded until last Friday. At the end of the third run the starting switch of Gar Wood's boat broke; even so the average speed for the three runs was 100·6 m.p.h. In a second attempt the record was raised still further, with runs at 100·755 and 101·551 m.p.h., giving an average speed of 101·154 m.p.h. Another attempt raised the figure still further to 102·155 m.p.h. The speed boat which Commodore Gar Wood was using is driven by two power units, each of 1100 horse-power, which have recently been fitted with superchargers. It will be remembered that before sailing for Buenos Aires, Mr. Kaye Don reached an unofficial speed of 107 m.p.h. in "Miss England II." on Lough Neagh. He will make an attempt on the record during the period of the Exhibition.

AN EXHIBIT AT THE BUENOS AIRES EXHIBITION

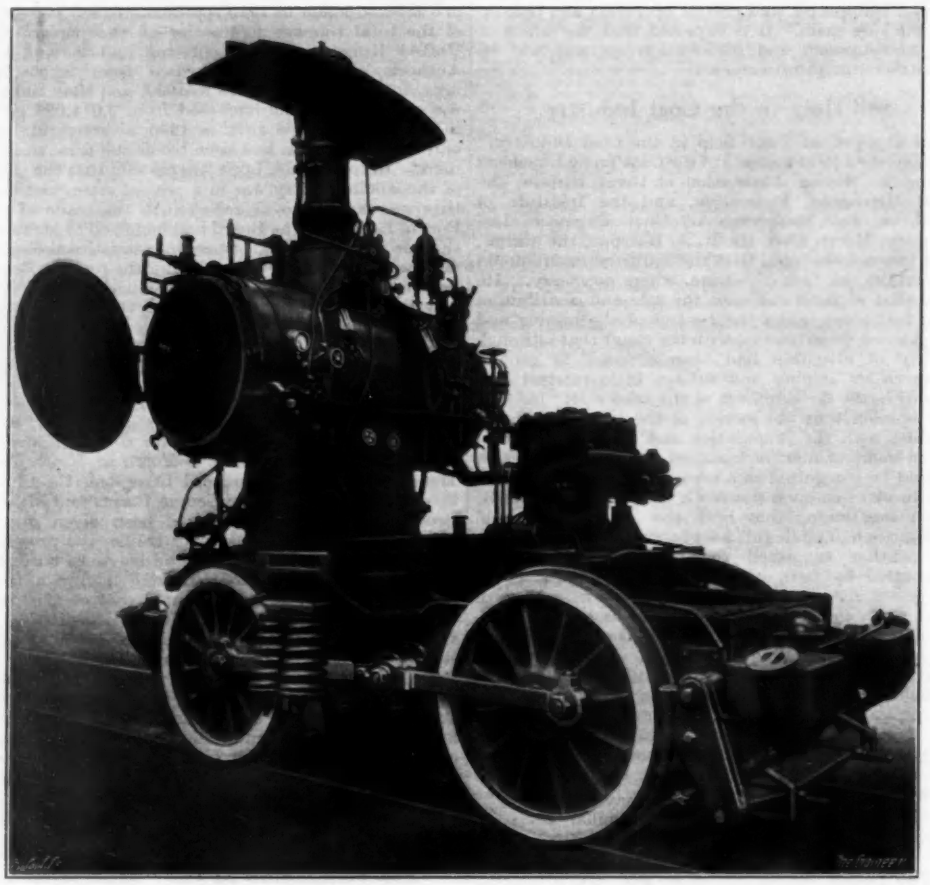


FIG. 23—POWER UNIT OF STEAM RAIL COACH—BIRMINGHAM

Buenos Aires Trade Exhibition.

No. III.*

THE BIRMINGHAM RAILWAY CARRIAGE AND WAGON COMPANY, LTD.

AMONG the railway exhibits an articulated steam rail coach built by the Birmingham Railway Carriage and Wagon Company, Ltd., of Smethwick, Birmingham, will attract considerable notice. It has been constructed for the Entre Rios Railways, to which it will be handed over at the close of the Exhibition.

Fig. 24 is a general arrangement drawing of the coach from which it will be seen that the driving cab and engine compartment are mounted on the leading bogie, and next to this is a second-class saloon. The second portion has a driver's cab at the extreme end, with a luggage compartment between it and the first-class saloon. The car will accommodate forty-two second-class and twenty-four first-class passengers. A flexible gangway connects the two coaches, which are constructed of mild steel throughout, the underframe being integral with the body.

The power unit, as can be seen from the photograph we reproduce in Fig. 23 is mounted complete on the driving bogie. It consists of a boiler manufactured by the Yorkshire Patent Steam Wagon Company, Ltd., of Leeds, and an engine by the same company. The boiler is constructed for a working pressure of 275 lb. per square inch, and is fitted with superheaters, giving a temperature of 600 deg. to 700 deg. Fah. at the engine. It has a heating surface of 158 square feet and a combustion volume of 21 cubic feet, and is arranged for oil burning, the apparatus being supplied by Laidlaw, Drew and Co. A similar apparatus supplied to Cochrans, Ltd., is described in the pages of the Supplement to our issue of March 13th. The makers claim for the boiler that whilst it has the compactness common to most vertical boilers, its large heating surface gives it a steaming capacity comparable with that of a locomotive. Access to the tubes can be gained by opening the smoke-box doors and the fire is visible to the stoker, so that when coal is used it can be properly trimmed.

As the engine is carried on the same bogie as the boiler, no flexible steam or exhaust pipes are required. The engine itself is of the "Yorkshire" three-cylinder double-acting balanced type, with a cast steel crank-case, and is suspended on rubber links at one end to prevent distortion. All the cylinders have a diameter of 5½in., with a stroke of 8in.; the piston valves, which are fitted, are operated by Joy valve gear. The engine develops 175 B.H.P. at a train speed of 40 m.p.h. It is totally enclosed, but access to any part can be obtained by removing a large cover plate on the crank case. The power is transmitted through two trains of gears running in oil baths from the crank shaft to the jack shaft, which is fitted in heavy bearings fixed to the power bogie. From the jack shaft the drive is transmitted to the axles by two balanced crank pins and side rods. The makers give the consumption of coal and water as 8 lb. per mile and 6·4 gallons per mile respectively.

The power bogie, which, with the boiler and engine, makes a single unit, is so constructed that it can be readily detached from the coaches, and another unit substituted, should an extensive overhaul become necessary.

The engine cab accommodates the boiler and engine, the water tanks with a capacity of 470 gallons, and the fuel oil tanks holding 174 gallons. The driving cab at the other end of the car is connected with the engine cab by a speaking tube, and a push-button signal bell is also fitted.

The main dimensions of the car can be seen from the drawing, Fig. 24. Complete with fuel and water tanks, it weighs 56 tons 8 cwt. 2 qr., while the power unit alone weighs 12 tons 3 cwt.

* No. II. appeared March 20th.

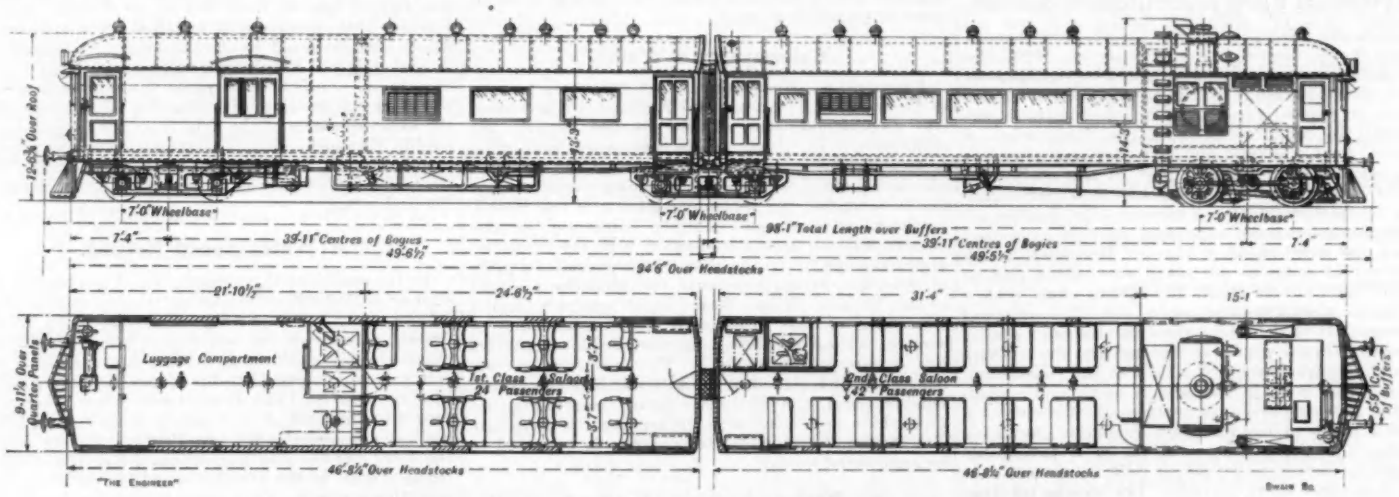


FIG. 24—GENERAL ARRANGEMENT OF ARTICULATED STEAM RAIL COACH—BIRMINGHAM

Entre los artículos expuestos relativos a F.C. está un coche motor articulado construido por la compañía de wagones y coches para F.C., Birmingham Ltda., de Smethwick, en Birmingham, que llamará mucho la atención. Ha sido hecho para el F.C. de Entre Ríos, a quienes será entregado al fin de la Exposición.

La Fig. 24, es un bosquejo de la disposición general del coche, por el que se verá que la cabina del maquinista y compartimiento de la máquina están montados en el bogui principal, y junto a este va el salón de segunda clase. La segunda porción tiene una cabina para el conductor en el extremo, con un furgón para encomiendas entre ella y el salón de primera clase. El coche puede llevar 42 pasajeros de segunda y 24 de primera. Un corredor flexible une los dos coches, los que están hechos de acero dulce totalmente, el bastidor bajo formando parte del conjunto.

La unidad motora, como se puede ver en la fotografía que reproducimos en la Fig. 23, va montada completamente en el bogui propulsor. Consiste en una caldera fabricada por la compañía Yorkshire Patent Steam Wagon, Ltda., de Leeds, y un motor de la misma compañía. La caldera está construida para una presión de trabajo de 275 libras por pulgada cuadrada (1933 gramos por cm²), tiene sobrecalentadores, dando una temperatura de 600 grados F. a 700 Grados F. en el motor (316 a 371 grados centígrados). Tiene una superficie de calefacción de 158 piés cuadrados (14,683 m.²) y un volúmen de combustión de 21 piés cúbicos (0,594 m.³). Está dispuesta para quemar aceite crudo, con quemador suministrado por los Sres. Laidlaw, Drew and Cía. Un aparato semejante entregado a los Sres. Cochrans, Ltda., está descripto en las páginas de nuestro Suplemento a la Edición del 13 de marzo. Los fabricantes pretenden que la caldera aunque retiene la solidez común a la mayoría de las calderas verticales, su gran superficie de calefacción le da una capacidad de vapor parecida a la de una locomotora. El acceso a los tubos se obtiene por la abertura en la caja de fuego y el fuego es visible al fogonero, de modo que cuando se usa carbón se pueda vigilar y arreglarlo.

Como el motor va soportado por el mismo bogui que la caldera. no se necessita caños flexibles para escape o para vapor. El motor mismo es del tipo "Yorkshire" de tres cilindros de doble acción equilibrados, con una caja de cigüeñales de acero fundido, y va suspendido de cáncamos de caucho en un extremo para evitar distorsión. Todos los cilindros tienen un alma o diámetro de 5½" (12,89 cm.) con una carrera de 8" (20,32 cm.); las válvulas para pistón que se provée, van mandadas por un mecanismo Joy para válvulas. El motor desarrolla 175 B.H.P. a una velocidad del tren de 40 millas por hora (64 km. hora.). Está totalmente encerrado, pero se tiene acceso a cualquier parte sacando una tapa de chapa que hay en el carter. La energía se transmite por medio de engranages que trabajan en baños de aceite, del arbol cigüeñal al eje intermedio,

el que va soportado por cojinetes pesados fijos en el bogui propulsor. Del eje intermedio, el esfuerzo pasa a los ejes por medio de dos muñones equilibrados y barras laterales. Los fabricantes dan el consumo de carbón y agua como de 8 libras por milla y 6,4 gallones por milla respectivamente (3,629 kg. por 1600 metros y 29,09 litros por 1600 metros respectivamente). El bogui propulsor, que con la caldera y el motor, forma una simple unidad, está construido de tal manera, que puede sacarse fácilmente de los coches y reemplazarse por otra unidad, en el caso de tenerse que hacer una reparación importante. La cabina de la máquina lleva la caldera y el motor, los tanques de agua con una capacidad de 470 galones, (2136 litros), y los tanques de aceite combustible para 174 galones (791 litros). La cabina de manejo al otro extremo del coche está unida con la de la máquina por medio de un tubo telefónico, y se provée además de una campanilla eléctrica con botón de presión para señales.

Las dimensiones principales del coche se ven en el dibujo, Fig. 24. Pesa completa con combustible y agua, 56 toneladas 8 quintales y 2 arrobas, y la unidad propulsora pesa sola 12 toneladas y 3 quintales.

SIEMENS BROTHERS AND CO., LTD.

Samples of submarine telegraph and telephone cables made at the Siemens Works at Woolwich and as laid by the manufacturers between various countries are shown by Siemens Brothers and Co., Ltd. One of these exhibits consists of a sample of continuously loaded submarine telephone cable designed for establishing telephonic communication across seas in which the depth of water does not exceed 150 fathoms, and represents the latest type of the cable which was laid in 1924 between England and Holland, a distance of 86 miles. The cable contains sixteen continuously loaded conductors arranged in four groups, each composed of four conductors. The copper conductor weighs 106 lb. per nautical mile and is "loaded" with inductance by means of annealed iron wire laid directly over the copper conductor in helical form, the cable containing eight physical and four phantom circuits. Besides this and other submarine cables there is an underground air space telephone cable containing 320 wires for long-distance telephonic transmission, and as designed by the British Post Office for the exclusive purpose of connecting up large centres of population.

Samples of power cables are also shown, and

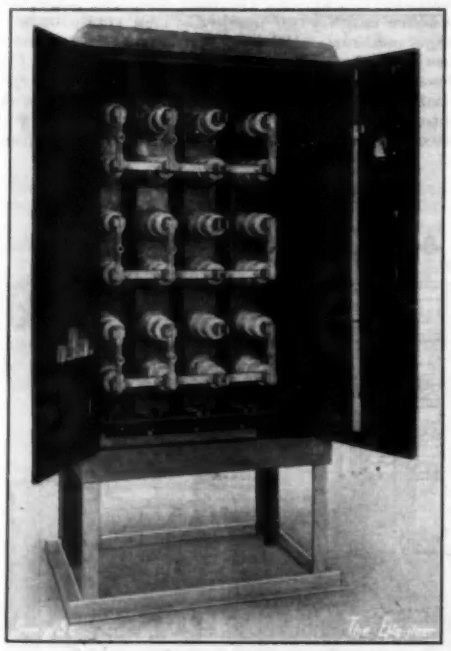


FIG. 25—HIGH TENSION PILLAR—SIEMENS

among these exhibits is a piece of three-phase power transmission cable of the "H" type, designed to ensure that all lines of dielectric stress are confined to the cores themselves, there being no tangential stresses in the interstices, such as are met with in the usual type of three-core cable. The cable is capable of transmitting 12,000 kVA at a working pressure of 33,000 volts. A sample of a three-phase H.S.L. power cable, which differs from the "H" type in that each insulated conductor is separately covered with lead and combines three single cables in one, is on view. The cable will transmit 16,000 kVA at 33,000 volts, and the sample exhibited is taken from a cable providing power transmission across the harbour at Sydney, New South Wales. The cable was manufactured and shipped to Australia in four lengths, each of 900 yards and each weighing 30 tons. There is a display of india-rubber insulated wires and cables manufactured by the company, these exhibits being representative of the various forms and sizes employed in the wiring of buildings for electric lighting and power.

For giving a high-tension supply to large consumers instead of connecting them to the low-tension network, the firm has designed a high-tension pillar as shown in Fig. 25, into which the ring main feeder is looped and the service is taken off by separate cables to the consumer's premises. The use of such a pillar effects considerable saving in capital outlay as compared with the scheme of using three oil break switches, and the design is such that the links can be safely withdrawn provided no load current is flowing and the length of cable to be rendered dead is not greater than one mile. The links are of a patented design with a positive hold-in catch so that they cannot be displaced owing to a heavy short-circuit current. The company supplies these pillars in types suitable for outdoor use, as well as pillars of lighter construction for use in buildings. A low-tension type exhibited is built up of sheet steel plates and special angle sections. It is fitted with four units for three-phase four-wire distribution cables, and all the parts are mounted on the front, enabling them to be renewed without dismantling the unit. The insulation is entirely of glazed porcelain. The fuses are of the porcelain handle shrouded type fitted with self-aligning contacts, but, if desired, links in similar handles with a quick break can be substituted for the fuses. The erection of the units can be carried out from the back of the pillar without dismantling any fuse fittings. End boxes for 3 kV, 6 kV, and 11 kV are also shown, the boxes being of cast iron with wiping glands to which the lead of the cable is to be plumbed. Porcelain insulators having ample surface are provided, and copper terminal rods are brought out through insulators which provide ample clearance between conductors and to earth.

An inverted type of pole terminal box, which is shown in Fig. 26, as introduced by the firm nearly thirty years ago, and suitable for pressures up to 22 kV, constitutes another exhibit. Boxes subjected to such violent changes in temperature as those met with on transmission line terminals require special provision for expansion of the compound, and these boxes are designed so that they have a definite volume of air at the top to provide a cushioning effect. An underground disconnecting box suitable for use on circuits up to 11 kV, and which may be used as an alternative to a high-tension feeder pillar, is shown. House fuses, "Stannos" and "Seelco" wiring materials, batteries, protective apparatus, and the "Neophone," which is a new and highly efficient telephone, are on view. The "Neophone" is said to embody the results of many years' careful research undertaken to produce an instrument of the microtelephone type possessing none of the shortcomings which have hitherto prevailed in instruments of this type when used on central battery circuits. It is claimed that the "Neophone" not only entirely eliminates howling, frying and excessive side tone, but is definitely superior, as regards speech transmission efficiency and articulation, to telephones of the solid back transmitter pattern. The superior efficiency of the instrument is largely due to an entirely new design of immersed electrode transmitter in conjunction with a special anti-side-tone circuit. The improved efficiency renders the instrument particularly suitable for long-distance transmission, and also makes possible the use of smaller conductor cables than would otherwise be needed. Both wall and table pattern instruments are shown, the latter with combined and separate bell sets.

Los Sres. Siemens Hermanos y Cía., Ltda., de Londres, exponen muestras de cables submarinos para telégrafos y teléfonos hechos en sus talleres, los Siemens Works, en Woolwich, que han sido colocados por los fabricantes entre varios países. Uno de los objetos exhibidos es parte de un cable de carga permanente para teléfonos submarinos proyectado para establecer comunicación telefónica através de aguas cuya profundidad no exceda de 150 brazas (275 metros), y representa el tipo último de cable colocado en 1924 entre Inglaterra y Holanda, una distancia de 86 millas (137·6 kilómetros). El cable contiene 16 conductores contínuamente cargados arreglados en 4 grupos, cada uno compuesto de 4 conductores. El conductor de cobre pesa 106 libras por milla náutica (48·08 kg. por 1609·3 metros) y está "cargado" por inductancia por medio de un alambre de acero recocido dispuesto en hélices directamente sobre el conductor de cobre, asi el cable tiene 8 circuitos físicos y 4 circuitos "fantasmas." A más de esto y otros cables submarinos, hay un cable para teléfonos subterráneos de espacio abierto o libre que contiene 320 alambres para transmisión a larga distancia, como el proyectado por el Correo Inglés para el uso exclusivo de comunicar centros de población extensos.

También se expone muestras de cables para transmisión de fuerza, y entre ellos se verá un pedazo de cable de transmisión trifásica del tipo "H," proyectado para asegurar que todas las líneas de deformación dieléctrica queden confinadas a los núcleos mismos, no habiendo deformaciones tangenciales en los intersticios, como sucede en los cables del tipo común de 3 ramales o núcleos. El cable puede transmitir 12,000 kVA a una presión activa de 33,000 voltios. Una muestra del cable para transmisión de energía trifásica H.S.L., el que difiere del tipo "H" en que cada conductor aislado va cubierto separadamente de plomo y combina 3 cables sencillos en uno, está aquí a la vista. El cable transmitirá 16,000 kVA a 33,000 voltios, y el trozo expuesto ha sido cortado de un cable que suministra energía através del puerto de Sydney, en Nueva Gales del Sud. El cable fué fabricado y embarcado para Australia en 4 trozos, cada uno de 900 yardas (822·06 metros) y 30 toneladas de peso. Se expone también un surtido de alambres y cables aislados con caucho fabricados por la firma, los que representan las varias formas y tamaños empleados en las instalaciones en edificios para alumbrado eléctrico y para energía.

Para poder suministrar energía a alta tensión a consumidores importantes en lugar de conectarlos a la red de baja tensión, la casa ha proyectado un pilón de alta tensión como el que se ve en la figura 25, en el cual el alimentador principal está arreglado para conectar a los cables separados que entran en el edificio. El uso de esos pilares efectúa una economía en el gasto inicial si se le compara con el de colocar 3 interruptores de aceite, y el diseño es tal que los puentes pueden ser sacados con seguridad siempre que no haya corriente de carga y que el largo del cable que se anula no sea mas de 1600 metros. Los

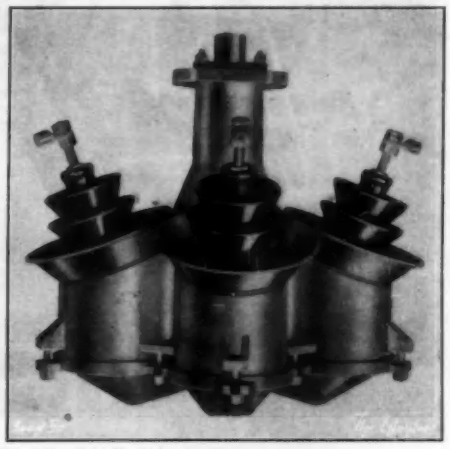


FIG. 26—TERMINAL BOX—SIEMENS

puentes son de diseño patentado con un agarre interno positivo de modo que no puedan saltar o salirse en caso de una corriente muy fuerte de corto circuito. La compañía suministra estos pilares en tipos convenientes para uso externo asi como también pilares mas livianos para uso dentro de los edificios. Un tipo de pilar para baja tensión se expone, el que está hecho de chapas de acero y fierros de ángulo especiales. El pilar va provisto de 4 unidades para cables trifásicos de distribución de 4 hilos, y todas las partes van colocadas en el frente, lo que permite sacarlas y renovarlas sin tener que desarmar la unidad. La aislación es toda de porcelana esmaltada. Los fusibles son del tipo de manija de porcelana protegida, con contactos de alineamiento automático, pero si se desea, se puede entregar en lugar de los fusibles, puentes con manijas semejantes de interrupción rápida. La erección de las unidades se lleva a cabo por atrás del pilar sin desarmar los accesorios de los fusibles. Cajas terminales para 3 kV., 6 kV., y 11 kV. están a la vista, las cuales son de hierro colado con enchufes en los cuales se asegura el extremo del cable. Se provée de aisladores que tienen una amplia superficie, y se sostiene los aisladores por medio de barras de cobre que dejan suficiente holgura entre los conductores y la tierra. Otro renglón expuesto es una caja terminal de polos del tipo invertido, vea Fig. 26, presentado por la casa 30 años hace, que es conveniente para presiones hasta de 22 kV. Las cajas sujetas a tan violentos cambios de temperatura como los producidos en los terminales de líneas necesitan tener en cuenta la expansión del material, y estas cajas están hechas de tal manera que disponen de un volúmen determinado de aire en el tope para que actúe como paragolpe. Una caja para desconectar, subterránea, utilizable en circuitos hasta de 11 kV y que puede usarse en lugar de un alimentador de pilar de alta tensión, se ve en el muestrario. También se verá fusibles para casas, materiales para instalaciones eléctricas "Stannos" y "Seelco," baterías, aparatos de seguridad, y el "Neophone" que es un nuevo y eficiente teléfono. El "Neophone" dicen que incorpora los resultados de muchos años de investigación minuciosa emprendida para obtener un aparato del tipo microtelefónico que no tuviera ninguno de los defectos que hasta ahora han dominado en los instrumentos de este tipo cuando se les usa con baterías centrales. Se dice que el "Neophone" no solo elimina "aullidos," "siseos" o tonos destemplados, sino que es definitivamente superior, por lo que respecta a eficiencia en la transmisión de la palabra y articulación, a los aparatos del tipo transmisor de fondo fijo. La eficiencia superior del instrumento se debe mayormente a un diseño enteramente nuevo de transmisor de electrodo sumido o inmergido combinado a un circuito especial "anti-tono-secundario." La eficiencia mejorada hace este aparato especialmente apropiado para transmisión a largas distancias, y también hace posible el uso de cables mas pequeños que los necesarios de otro modo. Se expone los dos

aparatos, el de pared y el de mesa, este último con juegos de timbres combinados o separados.

THE ENGLISH ELECTRIC COMPANY, LTD.
BELLISS AND MORCOM, LTD.
TANGYES, LTD.

A joint exhibit by the English Electric Company, Ltd., of London, Stafford and Rugby, Belliss and Morcom, Ltd., of Birmingham, and Tangyes, Ltd., of Birmingham, may be regarded as the "power-house" for the stands of Messrs. Evans, Thornton and Co., and Parson and Crossland, Ltd., who have organised the combined exhibit. Apart from an English Electric alternator and D.C. generator which will be exhibited running direct-coupled to oil engines made by the two other firms above named, and the necessary switchgear, most of the other exhibits consist of photographs and publications. These show and describe the steam turbines and condensers, water turbines, oil engines, transformers, switchgear, automatic sub-stations, synchronous condensers, frequency changers, electric locomotives, motor coaches and trolley omnibuses, &c., and various industrial electrification schemes which have been carried out and supplied by the English Electric Company, from its various works. The English Electric generator coupled to the Tangye engine is of the level compounded type, with end-shield roller bearings, and in connection with it a 1350 r.p.m. rotary balancer set, designed to deal with 25 per cent. of the full load current of the 30 kW D.C. generator is shown. The switchgear consists of two 1in. ebony Sindanyo panels on tubular steel framework, for either floor or wall fixing, with the necessary switches, fuses and measuring instruments.

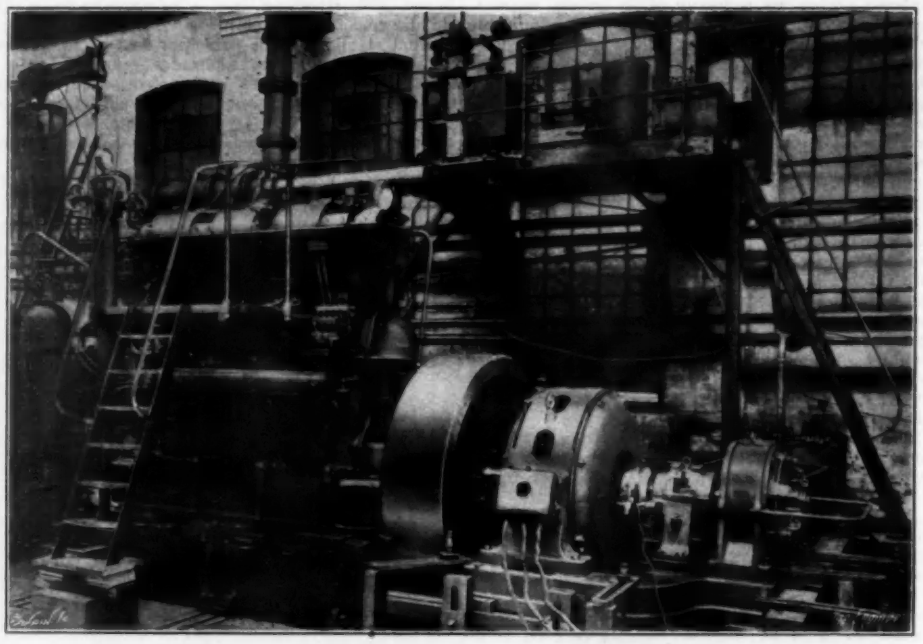


FIG. 27—210 B.H.P. OIL ENGINE—BELLISS AND MORCOM

The largest power unit on the stand is a three-cylinder, high-efficiency Belliss and Morcom oil engine operating on the four-stroke, single-acting principle with air injection. A view of the engine on test in the makers' works is reproduced in Fig. 27, while in Fig. 28 a sectional elevation is given. The cylinders have a bore of 12¾in. with a stroke of 16in., and the normal output is 210 B.H.P. at 375 r.p.m., which has been slightly reduced to suit the English Electric Company's alternator, the designed output of which is 120 kW, three-phase, 220 volts at 50 cycles.

The design of the engine follows the makers' standard practice for land and marine oil engines, and it may be noted that a very robust bed-plate and crank case, working with a dry sump, is utilised. The engine occupies small space, and the height required for withdrawing the pistons is low. A mean piston speed of about 1000ft. per minute has been adopted, and with a mean indicated pressure of less than 100 lb. per square inch gives good overload capacity and easy operation under continuous full load conditions. The weight of the engine is of interest, as, with the starting receivers and exhaust silencers, &c., it is only about 180 lb. per B.H.P. All the principal parts of the engine are furnished with forced lubrication, and hand oiling has been reduced to an absolute minimum. The lubricating oil consumption has been found to be within 1 per cent. of the full load fuel consumption, which is 0·4 lb. to 0·41 lb., or 0·182 kilos. to 0·186 kilos. per B.H.P. hour.

The engine is furnished with a chain-driven circulating pump, which forces the fuel through a copper coil encircling the exhaust pipe, thereby preventing the setting of the fuel and enabling the local Commodora Rivadavia fuel, with its high asphaltic base, to be used. The makers can supply engines working with either air or airless injection, but the air injection engine has been chosen for exhibition purposes on account of its ability to run steadily over long periods at a very light load.

The exhibit of Tangyes, Ltd., of Cornwall Works, Birmingham, is a single-cylinder, low-compression, heavy-oil engine, with a designed maximum output of 60 B.H.P.—see Fig. 29—which is shown running at 48 B.H.P., coupled to a 30 kW, 250 r.p.m., D.C. generator by the English Electric Company, through a flexible coupling. The engine embodies all the latest Tangye improvements, including a super-compression attachment, which, during the few starting revolutions, enables the air compression to be increased, giving certain ignition. The combustion chamber is furnished with a patented sheath, the purpose of which is to enable the engine to run on oils with a heavy asphaltic or bitumen content. The engine is of the cold-starting type, compressed air being employed, and the fuel consumption is about 0·42 lb. per B.H.P. hour. The engine exhibited is representative of a line of eleven single-cylinder engines embracing outputs from 28 to 135 B.H.P. for industrial or power station work, and seven two-cylinder coupled engines with outputs from 104 up to 270 B.H.P.

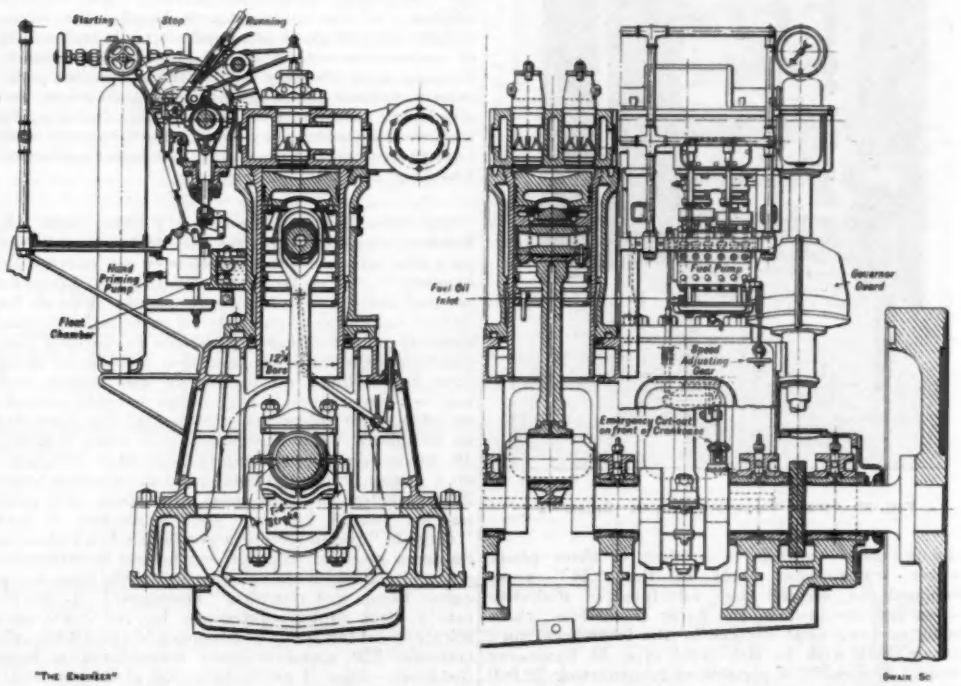


FIG. 28—SECTIONAL ELEVATIONS OF 210 B.H.P. OIL ENGINE—BELLISS AND MORCOM

Una exposición colectiva de la English Electric Company, Ltda., de Londres, Stafford y Rugby; de Belliss y Morcom, Ltda., de Birmingham; y de Tangyes, Ltda., de Birmingham, puede considerarse como la "casa-usina" del pabellón de los Sres. Evans, Thornton y Cía., y Parson y Crossland, Ltda., que la han organizado. A parte de un alternador y un generador para corriente contínua English Electric, que se verán trabajando acoplados directamente a motores de petróleo hechos por las otras dos casas mencionadas mas arriba, y los cuadros de distribución necesarios, la mayoría de los otros renglones expuestos son fotografías y material impreso. Estas muestran y describen las turbinas de vapor y condensadores, turbinas de agua, motores de petróleo, transformadores, cuadros de distribución, subestaciones automáticas, condensadores sincrónicos, cambiafrecuencias, locomotoras eléctricas, coches motores y ómnibus eléctricos con trolleys, etc., y varios proyectos de electrificación ejecutados y suministrados por la compañía English Electric, de sus varios talleres. El generador English Electric acoplado al motor Tangye es del tipo "level compound" con cojinetes de rodillos de borde protegido, y en combinación con un juego compensador rotatorio de 1350 revoluciones por minuto, proyectado para operar con 25% de la corriente total de carga del generador de 30 kW de corriente contínua que está a la vista. El cuadro de distribución consiste en dos paneles de 25,4 mm. de espesor de ebonita Sindanyo soportados por un armazón de tubos de acero, para fijar en el piso o en la pared, con los interruptores necesarios, fusibles e intrumentos de medida.

El productor mas grande de energía en este pabellón es un motor de tres cilindros, de gran eficiencia, de Belliss y Morcom, de petróleo, que actúa en cuatro ciclos, con simple acción e inyección de aire. Una vista del motor en el banco de pruebas en los talleres de la casa se tiene en la figura 27, y un corte vertical en la figura 28. Los cilindros tienen un alma o diámetro de 12¾" (323,85 mm.) y una carrera de 16" (40,68 cm.), y el rendimiento normal es de 210 caballos ingleses a 375 revoluciones por minuto, la que ha sido reducida algo para adaptarla a la del alternador de la compañía English Electric, cuyo rendimiento calculado es de 120 kW., trifásico, 220 voltios a 50 ciclos.

El dibujo de la máquina sigue la práctica normal de los fabricantes para sus motores de petróleo, terrestres y marinos, y se notará que se adopta una base y carter muy robustos, que trabajan con sentina seca de aceite. El motor ocupa muy poco espacio, y la altura requerida para sacar plosistones es baja. Se ha adoptado una velocidad media de pistones de cerca de 1000′ por minuto (304,79 metros) y con una presión media indicada de 100 libras por pulgada cuadrada (7,03 kg./cm.²) permite una buena capacidad de sobre carga y un maejo fácil en condiciones de cargas contínuas. El peso del motor es interesante, pués con los receptores para el arranque y los silenciadores, etc., es solo cerca de 180 libras por caballo (81,72 kg.). Todas las partes principales del motor van provistas de lubrificación forzada, y el enaceitado a mano ha sido reducido a un mínimo absoluto. El consumo de aceite para lubrificación ha resultado ser de menos que 1% del aceite total de combustión a toda carga, que es de 0,4 libras a 0,41 libras o 0,182 kilos. a 0,186 kilos. por caballo hora. El motor tiene una bomba de circulación mandada por cadena, la que fuerza al aceite a pasar por un serpentín de cobre que rodea el tubo de escape, impidiendo así el depósito del petróleo y permitiendo el empleo del petróleo de Comodoro Rivadavia local a pesar de su alto contenido asfáltico. Los fabricantes pueden suministrar motores que trabajen con inyección de aire o sin ella, pero se ha elegido la

máquina con inyección de aire para la Exposición por la razón de su facilidad para trabajar uniformemente durante largos períodos con una carga muy liviana.

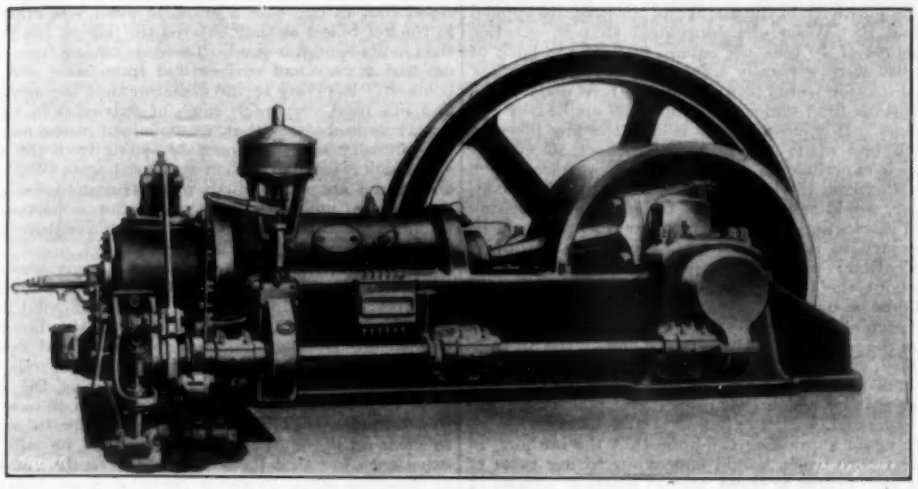


FIG. 29—48 B.H.P. OIL ENGINE—TANGYE

Lo expuesto por Tangyes, Ltda., de Cornwall Works, en Birmingham, es un motor de aceite pesado, baja compresión, de un cilindro, con un rendimiento calculado máximo de 60 caballos—vea figura C44—que se verá trabajando a 48 H.P. acoplado por intermedio de un acoplamiento flexible, a un generador de corriente contínua de 30 kW de 250 rev. por minuto, de la English Electric Company. El motor comprende todas las últimas mejoras de Tangyes, incluidos el mecanismo de sobre compresión, el que, durante las vueltas de arranque, permite aumentar la compresión del aire, dando una ignición segura. La cámara de combustión está provista de una vaina patentada, cuyo objeto es el permitir al motor utilizar aceites o petróleos de contenido alto en asfalto o betún. El motor es del tipo de arrancar en frío, usando aire comprimido, y el consumo de combustible es de cerca de 0,42 libras por caballo inglés por hora (190 gramos). El motor expuesto representa una serie de once modelos de un cilindro que comprende rindes desde 28 hasta 135 caballos de fuerza, para industrias o para usinas de energía, y siete modelos de motores de dos cilindros acomplados con rendimientos de 104 hasta 270 caballos ingleses de fuerza.

SIR W. G. ARMSTRONG, WHITWORTH AND CO., LTD.

Sir W. G. Armstrong, Whitworth and Co., Ltd., of Newcastle-upon-Tyne, have arranged their exhibits to give as good an idea as possible of the range of manufactures which they are ready to undertake.

The locomotive, of which we reproduce a photograph in Fig. 30, is exhibited by the permission of the Central Argentine Railway—5ft. 6in. gauge—for which twenty of the same type were recently supplied. It has three cylinders and, as can be seen from the engraving, is of the 4–6–2 type. Its total weight with tender in running order is 171·8 tons, and it develops a tractive effort of 17,237 kilos.—about 38,000 lb. Caprotti valve gear is fitted. The firm is also exhibiting a Spencer-Hopwood boiler; it is of the vertical water-tube type fitted for coal firing and has a normal evaporative capacity of 1595 lb. per hour.

Owing to lack of space on the stand the makers have only been able to show one of the complete range of their die-casting machines. The one shown is adapted for the re-metalling of axle-boxes, and is complete with a de-metalling oven, tinning bath and extended working table. We illustrate this machine in Fig. 31. The makers claim that the time saved by employing this highly specialised process soon saves sufficient money to repay the original cost. The machine is shown in operation and should prove of considerable interest to engineers interested in railways.

The other exhibits on the stand give some idea of the great variety of machines made by the firm. We may mention pneumatic tools of robust construction of all kinds; a crucible type furnace equipped for oil firing, suitable for melting aluminium, with a capacity of 1000 lb.; a Middleton cotton gin fitted for semi-automatic lubrication and equipped with ball bearings throughout; and an open flame semi-rotary furnace. A variety of types of packing made by the British Metallic Packings Company, Ltd., of Princes-street, London, is also shown upon this stand.

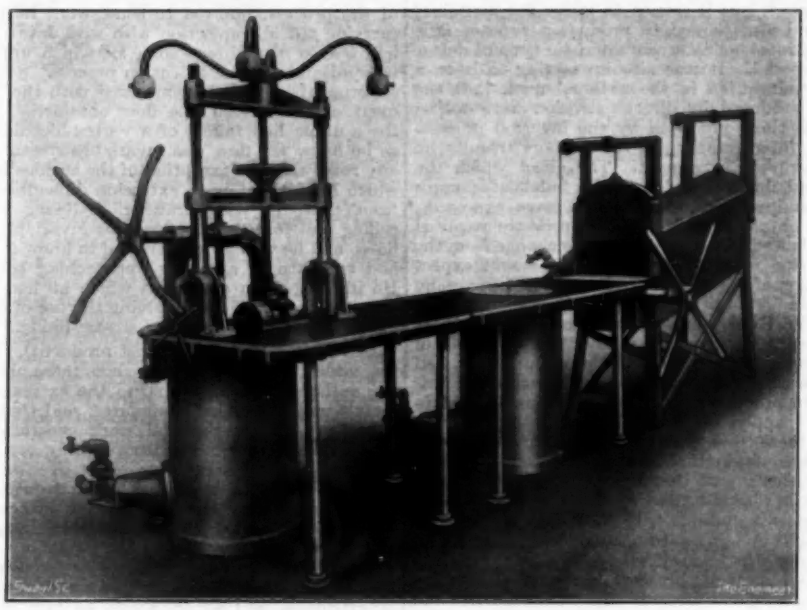


FIG. 31—AXLE-BOX DIE-CASTING MACHINE—ARMSTRONG

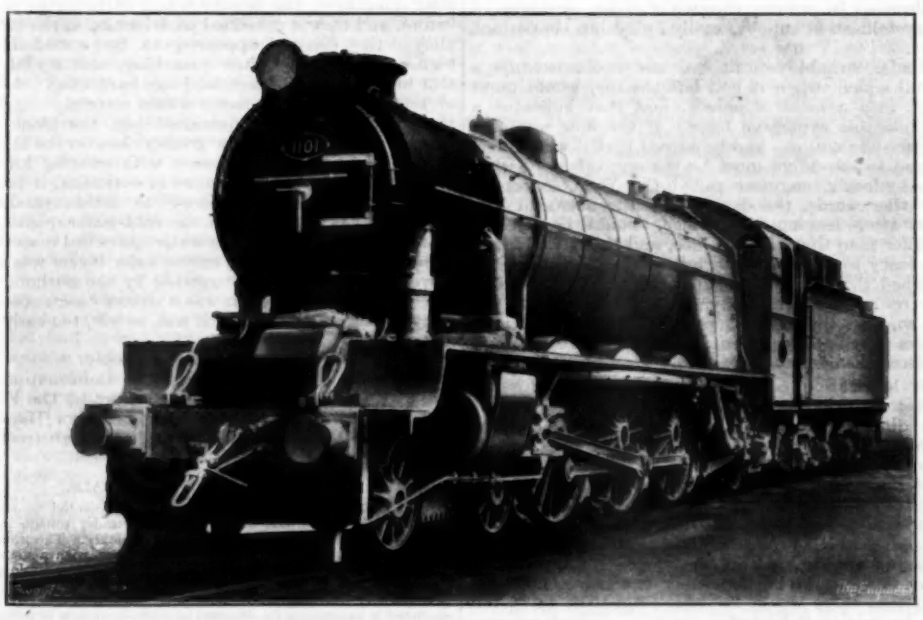


FIG. 30—LOCOMOTIVE FOR CENTRAL ARGENTINE RAILWAY—ARMSTRONG

La sociedad anónima Sir W. G. Armstrong, Whitworth, Ltda., de Newcastle-on-Tyne, han dispuesto sus artículos expuestos para dar una idea tan buena como es posible de la variedad de renglones que está preparada para manufacturar.

La locomotora, de la cual reproducimos una fotografía en la Fig. 30, se expone con el permiso del F.C.C.A.—trocha 5′ 6″ (1,6765 metros)—a quienes se entregó veinte del mismo tipo recientemente. Tiene tres cilindros y, como puede verse en el grabado, es del tipo 4–6–2. Su peso total con el tender en tren de marcha es 171,8 toneladas, y desarrolla un esfuerzo tractor de 17,237 kilos. cerca de 38 000 libras. Provistas de articulación Caprotti para las válvulas. La firma también expone una caldera Spencer-Hopwood; es del tipo de tubos de agua verticales adaptada para quemar carbón y tiene una capacidad normal de evaporación de 1595 libras por hora (724 kilos.). Debido a la falta de espacio en el estante, los fabricantes solo han podido mostrar un juego completo de las máquinas para fundir en matrices. La expuesta se usa para reponer el metal en las porta-cojinetes de eje, y va completa con una estufa para sacar el metal de los mismos, un baño de estañar, y una bancada extensible para trabajar. Esta máquina está representada en la figura 31. Los fabricantes dicen que el tiempo economizado empleando este procedimiento altamente especializado, economiza pronto bastante dinero para compensar el costo original. Se verá trabajar la máquina e interesará mucho a los ingenieros vinculados con ferrocarriles. Los otros renglones expuestos en el estante dan una idea de la gran variedad de máquinas fabricadas por esta firma. Mencionaremos las herramientas neumáticas de todas clases, de robusta construcción; un horno del tipo para crisoles adaptado para quemar petróleo, útil para fundir aluminio, con una capacidad de 1000 libras (454 kilos.); una carda para algodón de Middleton preparada para enaceitado semiautomático y provista de cojinetes de bolas en todas partes; y un horno semirotativo para llama abierta. Una variedad de empaquetaduras hechas por la British Metallic Packings Company, Ltd., de Princes-street, de Londres, está también a la vista en este escaparate.

(To be continued.)

WHAT is claimed to be the largest motor generator ever built to supply power to motors driving a blooming mill has been made at the East Pittsburgh works of the Westinghouse Electric and Manufacturing Company. It consists of three 3000 kW generators and a 6500 H.P. induction motor, and it will furnish power for two 5000 H.P. double-unit reversing motors for twin drive on a blooming mill. The fly-wheel is 15ft. in diameter and weighs 180,000 lb.

The Institute of Metals.

No. II.*

The first paper taken on Thursday, March 12th, was one by Mr. C. E. Pearson and Dr. J. A. Smythe on "The Influence of Pressure and Temperature in Extrusion of Metals." The official abstract is given below.

THE EXTRUSION OF METALS.

The paper describes experiments made in a small press on the extrusion phenomena of the metals lead, cadmium, bismuth, and tin. The mechanism of the flow of metal during extrusion by the direct and inverted methods has been studied, and some attention has been given to certain of the extrusion defects met with in technical practice, and the work of former authors in this field has been confirmed and extended. The chief part of the work is concerned with the determination, under precise control, of the relationship between the rate of extrusion, pressure, and temperature. This relationship is expressed in a series of curves, the mathematical treatment of which is indicated.

Mr. R. Genders said that quantitative data on the extrusion process had long been needed, and although the results of the work described in the paper related to relatively soft metals at low temperatures and on a small scale, there was little doubt that those results were broadly applicable to large-scale work. Discussing the comparison between the direct and the inverted extrusion methods, he said that, regarded from the point of view of power and plant, the direct process was fundamentally uneconomical. The figures given by the authors, which amplified those relating to brass, showed that in the direct process only from 50 to 70 per cent. of the pressure was usefully applied; the remainder was waste, and was used merely to overcome friction at the surface. Not only was that power wasted, but it served to stress the container unduly and also tended to produce a type of flow capable of introducing a characteristic type of defect in the material. It was also interesting to have a further confirmation in the authors' work that the materials produced by direct extrusion were not so uniform as those produced by the inverted process. With the interpretation of the authors' results he was in complete agreement. The effect which the authors had obtained by lubricating billets of bismuth was rather greater than he would have expected; they had obtained a drop in the pressure required equal to that which resulted from the change from the direct to the inverted process. One would expect some portion of the pressure to be used in overcoming the friction.

Dr. H. W. Brownsdon, whilst thanking the authors for having brought out so many things capable of application, suggested that the procedure they had adopted was so far removed from that which was followed in practice that it might be somewhat dangerous to apply their conclusions generally. In practice there was first, the inability to control temperature within the very narrow limits adopted by the authors, and that caused very complicated variations in plasticity and pressure, which appeared to be almost inevitable. If those in the industry could maintain temperature conditions constant to within 1 deg. Cent., they would be able to produce products of a much greater degree of uniformity than was possible at present. Again, the authors had adopted an abnormally slow rate of extrusion. One reason was that the metal became heated at higher rates of deformation, but at the same time, he, the speaker, suggested that a few experiments at a normal rate of extrusion would have been of very considerable value, in order to ascertain whether the relationships brought forward did really apply at considerably higher pressures and higher rates of extrusion.

A reason given for using short billets when specially hard alloys were to be extruded was that as the length was reduced the amount of shearing at the sides decreased. He did not think, however, that that was the main reason why short billets were used in practice. The temperature gradient from the temperature of the billet when put into the container to that applying at the end of the extrusion process, was so steep that unless the extrusion period was very short, the metal lost considerable temperature and plasticity, and extrusion was no longer possible. The shearing forces were reduced, of course, when short billets were used, but the main reason for their use was the necessity of maintaining temperature conditions as uniform as possible. In practice one was not so much concerned with power as with the production of a good quality product, and one of the easiest ways of overcoming many of the extrusion defects was to shear the dirty outside of the billet by using a smaller gag, thus obtaining a much cleaner product than would be obtained otherwise, though it was recognised that in using a smaller gag power was being lost in the shearing process.

The statement that rod made by the inverted process was more uniform in structure in a longitudinal direction than that made by the direct process, could be confirmed. One had to consider the purpose for which the material was required, and if one had to work to a very close specification as regards the physical properties of the material, it was generally found that the inverted process was the best by reason of the greater uniformity from the front to the back end of the rod.

With regard to lubrication, he suggested that there was some danger in attempting to apply the results obtained with lead, tin and bismuth to metals which required a higher temperature and high pressure, because the friction between the deformed billet and the walls of the container must depend very largely on the plasticity of the metal and the pressure applied behind it. When one considered that in practice pressures of 40 tons per square inch at the back of a billet were generally used for brasses, the effect of lubrication would be much less marked under those conditions than under the conditions applied by the authors. It appeared that it was the low pressure which had made the lubricating effect so evident in their experiments, and that higher pressure, which would expand the billet more to the walls of the container, would result in a less beneficial effect arising from lubrication. He did not know that it should be necessary to use molten metals in order to obtain lubrication; probably, inorganic salts which melted at about the temperatures of the extrusion process could be used as lubricants.

It seemed to him that the rate of extrusion depended upon the plasticity of the material and on the pressure applied, and he suggested that in any future work the authors might consider the possibility of obtaining some unit by which that property of plasticity could be expressed.

In again expressing the hope that the authors, in their future work, would endeavour to use rates of extrusion nearer to those used in practice, instead of abnormally low rates, he pointed out that the economy of the process depended on getting through the cycle in the minimum time, which meant high pressures and high rates of extrusion, and, unfortunately, high temperatures.

Professor F. C. Thompson, discussing the mechanics of the process, referred to some work he had been carrying out in connection with wire drawing, which had led to conclusions some of which appeared to be applicable to the extrusion process. Some of his experiments had been concerned with the measurement of the stream line flow obtained. Although the authors had talked of a vortex-like flow, so far as he knew the flow was invariably stream-lined, at any rate, with the exception of the curious bend over which led ultimately to extrusion difficulties. Apart from that, in wire drawing, ordinary extrusion, rolling and forging, the flow was invariably stream-lined, and he would be interested to know if anybody had evidence of anything approaching eddy flows. He illustrated an apparatus which he had used for investigating the flow, involving the use of a red and a clear glycerine to show the stream-lining.

Dr. Walter Rosenhain (Past-president), discussing the extent to which results such as those obtained by the authors were applicable to the extrusion of hot metals under very high pressures, said that his own experience of experimental work generally showed that modern experiments were usually very fruitful, provided that the results were not over-interpreted. To that extent he agreed with Dr. Brownsdon that it was not entirely safe to apply the authors' results to metals extruded at much higher temperatures and pressures. But his reason for saying that was different from that put forward by Dr. Brownsdon. He did not think that the relations of power, speed of extrusion, and so on would be very materially affected by the fact that much higher pressures were being applied, but he did consider that the temperature had a very important effect. The extrusion speed was not usually excessive, nor was the cooling of the metal during the process exceptionally fast, but under the very severe plastic deformation which the metal underwent in passing through the die, processes of recrystallisation might easily play an important part.

Under suitable conditions, one could extrude a metal which, when it had left the die, would burst open into a mass of shreds, and that indicated a considerable expansive force. If the flow was of a stream-line nature—and he agreed that it was almost bound to be—there must be the equivalent of what the hydraulic engineer called the Vena contracta. In other words, the diameter of the extruded bar, just after leaving the orifice, would be slightly smaller than that of the orifice, and there would be a tendency to expand. But, by the time the metal had reached the point at which it wanted to expand as the result of the hydrodynamic effect, it could not do so, and therefore, it was left in a condition of stress which was sufficient, under suitable conditions, to burst the bar.

If lubrication could overcome the difficulties of direct extrusion, it would be all to the good, because the direct process was so much simpler than the inverted process. Although he admired Mr. Gender's development of the latter, it did involve the use of a rather awkward type of plant. He put forward, as an idea—though not as a practical solution to the lubrication problem—the insertion of a liner of graphite, which would crumble to powder under the pressure applied, in the container. He appreciated that that would be hopelessly expensive, however, and that there would be other objections to it, but the suggestion indicated a direction in which progress might be made.

Mr. Pearson, replying to the discussion, said that the thin rods obtained by extrusion in bismuth had curious properties. If they were deformed rapidly they would break up, but if they were deformed slowly, they could be twisted almost into knots. With regard to lubrication, he realised that there would be many difficulties in its application to ordinary commercial practice, but, possibly, it might be of some use if the right agent could be found. He understood that in one case a graphite wash was applied to the hot billets as they entered the passes, but that the results were not good. The rods issuing from the die had a very bad surface and there were defects below it. Replying to the criticism that the authors had not used very high rates of extrusion in their experiments, he said that, as explained in the paper, the difficulty was that the rods issuing from the die, when high rates of extrusion were used, were very hot, and it did not seem worth while trying to connect up pressure and rate of extrusion for a particular temperature when, apparently, the temperature was varying so much at the die surface.

With regard to the possibility of some kind of eddy flow in extrusion, he said that when watching the press recently, working on very large solid rod, he had noted that the rod coming from the dies was twisted on its axis, and it probably twisted round twice in a distance of about 30ft. That might indicate some kind of eddy in the metal entering the die. Replying to Dr. Brownsdon's reference to the use of the clearance between a gag and cylinder in order to shear off the unclean skin of the billet, he said his experience was that there was a limit to the amount of clearance which could be provided there, because when the annular space exceeded a certain limit there was a certain amount of back extrusion.

A paper on "The Dimensional Stability of Heat-treated Aluminium Alloys," by J. D. Grogan and D. Clayton, of which we print the official abstract, was then read and discussed.

HEAT-TREATED ALUMINIUM ALLOYS.

Careful search has failed to reveal the occurrence of secular change in certain commercial heat-treated aluminium alloys, subsequent to the completion of the normal ageing process. Serious dimensional changes occur when machining operations are carried out on material quenched in cold water. These changes are reduced to relatively small proportions in Y alloy and duralumin, the only alloys examined in this way, by the employment of boiling water as quenching medium. Cold cotton seed oil produces intermediate effects. These alloys, when quenched in boiling water, develop satisfactory mechanical properties.

Dr. A. G. C. Gwyer said that the authors had laid one of the bogies which those interested in aluminium alloys had had to face, namely, that of secular changes with time. He suggested, however, that, perhaps, the authors might have studied a little further the dimensional changes due to release of stresses, with a view to elucidating what might be regarded as the optimum heat treatment from that point of view. As to the difference in Brinell hardness between the centre and the circumference, he asked if that might have been due, in part, at any rate, to differences in composition, or to differences in micro-structure or to unsoundness.

Mr. H. Sutton said he was particularly interested in the suggestion that the change of stress due to changes occurring during the quenching and age-hardening of the alloys was of much influence upon the properties. The idea that the surface was strongly in compression in alloys quenched in cold water, that the fissures when formed would tend to close up, and that inter-crystalline attack would be inhibited in a mechanical way, was most valuable. There was a considerable difference between duralumin and several of the alloys having similar composition, but which were free from magnesium. Published work appeared to indicate that in duralumin, immediately after quenching, the density was a little higher than before, and that it remained so, whereas, in the other alloys, the density appeared to be considerably higher immediately after quenching, and would be still higher after the artificial age-hardening. Some of the graphs in the paper would certainly suggest that in the cold-water-quenched bar, the pinch on the external layer would be greater than on the inside portions. That was consistent with existing knowledge with regard to resistance to corrosion, it being recognised that the tendency to inter-crystalline corrosion was much less in the cold-water-quenched material than in the boiling-water-quenched material. Whether the compression in the outer layers was the correct explanation, as suggested by the authors, or whether that compression was a circumstance accompanying some other defect, it was, as yet, too early to say.

Mr. J. D. Grogan made a short reply.

The next paper was one on "The Deformation of Metals Under Prolonged Loading: Part I., The Flow and Fracture of Aluminium," by Professor Hanson and M. A. Wheeler, of which the official abstract is as follows:—

THE DEFORMATION OF METALS.

Introduction.—It is known that metals subjected to static stresses for long periods of time will fail under tensile loads less than those necessary to break them quickly. The present paper describes experimental work carried out with a view to studying the mechanism of flow and fracture under prolonged loads.

Method of Investigation.—The principal method used has consisted in examining the changes in micro-structure of polished specimens, subjected to static stresses at room and elevated temperatures. Aluminium was chosen principally because it exhibits the phenomena of "creep" at moderate temperatures at which a polished surface capable of revealing the micro-structural features of deformation can easily be preserved. A further advantage of this metal is that the mechanism of its deformation under many other types of stressing has already

* No. I. appeared March 20th.

been studied. Specimens consisting of ordinary aggregates of crystals, of crystals of widely differing size, and of single crystals have been used. Measurements of the densities of the broken test pieces have also been made. A few experiments have also been made with lead.

Conclusions.—(1) The extension under a prolonged load that will ultimately break the metal may be conveniently considered as consisting of three periods—(*a*) a period of primary extension, during which the rate of flow diminishes; (*b*) a period during which flow is very slow or even suspended; (*c*) a period during which the extension again continuously increases until fracture occurs. (2) During the first period the flow of the metal is the result of slip within the crystals, and flow diminishes owing to the hardening effect of slip. (3) The behaviour during the second and third periods varies with different specimens. (4) Three types of failure have been recognised under creep conditions—(*a*) Failure by intercrystalline cracking, cracks form while the elongation is low, and the metal fails with little reduction of area at the fracture; (*b*) failure by the resumption of slipping within the original crystals, leading to a fracture of the normal tensile type; (*c*) failure through the recrystallisation of the metal, removing strain hardening and permitting further flow of the softened metal; the metal pulls out to a point fracture, with a high elongation. (5) Aluminium can fail by "creep" at room temperature. (6) Aluminium consisting of uniform aggregates of crystal fails at 250 deg. Cent. by intercrystalline cracking. (7) Aluminium aggregates at room temperature, and aluminium single-crystal specimens at all temperatures, fail under creep conditions by shear along the slip planes. (8) In single crystals when flow recommences slip occurs only on some of the surfaces that had previously slipped during the primary flow. (9) The prolonged action of a suitable stress can cause disintegration of a metal either at the junctions of the grains or on surfaces of previous slip, and failure—*i.e.*, fracture—must be regarded as having commenced when this weakening occurs. (10) Under suitable conditions, *e.g.*, in crystal aggregates with moderate rates of flow at 250 deg. Cent., or with very slow rates of flow in single crystals, slip is distributed over a very large number of slip surfaces, and a polished surface of the metal may show little or no signs of slip bands. (11) No change in density is believed to occur when a crystal is distorted by moderate amounts; changes in density in the case of crystal aggregates are thought to occur at grain boundaries. (12) The view is expressed that rupture of the crystals commences along slip planes formed at an early stage in the deformation of the metal. (13) The results are consistent with the theory of slip and rupture previously advanced by Gough, Hanson, and Wright.

Dr. H. J. Gough, M.B.E., suggested that the proper attitude to take with regard to the paper was that we were not yet in a position to discuss it. We were trying to find out how metal was deformed and fractured, and he supposed there were three primary causes—mechanical stress, temperature and chemical stress (or corrosion). The way to tackle these three fundamental factors was to start with a single crystal, and then to build up aggregates of two and larger numbers of crystals, and work on them. A lot had been published with regard to mechanical stress, and a lot more was coming; there were two papers ready for publication, dealing with the effect of chemical stresses, which would throw valuable light on the matter, and there was a paper by Professor Hanson and Mr. Wheeler, dealing with the effect of temperature. When all that information was collected together, metallurgists should be in a position to consider what it meant, and probably to draw up some sort of descriptive theory. It seemed that the time was not opportune to discuss the details, which, he believed, could be proved mathematically.

Dr. Walter Rosenhain said that perhaps the cautious, or futuristic, attitude adopted by Dr. Gough was wise, but, nevertheless, there were certain aspects of the work described in the paper which it was worth while mentioning. It would not disturb his ideas, he said, to find that under certain conditions of loading a crystal could undergo deformation by continuous shear rather than by discontinuous slip. In other words, that slip would occur on a very large number of planes, if not on every plane, instead of on only a comparatively small number. But the evidence was of an experimental character, and could not be tested by mathematical methods. The question as to whether a systematic theory could be built up by working on single crystals and aggregates of crystals was very important, and he did not think it was a foregone conclusion that it could be done. There was a difference of fundamental conditions as between a crystal whose boundaries were free and crystals which were very firmly held by adjacent crystals and the material between them. Further, in a test piece containing only a very few crystal boundaries, or, perhaps, only one, the conditions of that boundary were very different from those of the ordinary intercrystalline boundary, in that it was stressed in a particular directional manner, which might occur here and there in the aggregate, but was certainly not representative of the average state of affairs. At the same time, he did not wish to deprecate work on single crystals. Another fact was that the single crystal had grown under conditions very different from those under which the crystals in an aggregate were formed, and probably its structure was more truly crystalline than that of the crystals which formed in the aggregate. In the same way, a plant which was growing alone developed differently from one in a jungle of other plants, each struggling for supremacy.

Mr. C. H. M. Jenkins asked whether the authors had examined any of their specimens in cross-section in order to ascertain the character of the cracks inside, because, although it might appear, from examination of the surfaces, that the cracks were inter-crystalline, he was rather of the opinion that some of the cracks extended a fair distance into the specimens and that they altered their character from the inter-crystalline to the trans-crystalline when inside. He also suggested that the authors had been fortunate in their choice of aluminium as the subject of investigation, because the temperatures of re-crystallisation were probably fairly low, and creep occurred at low temperatures. If they had worked with a metal in which creeping occurred at rather higher temperatures they might have found trans-crystalline fractures.

Mr. E. H. Bucknall said that in connection with some work he had carried out on copper locomotive stay rods, there seemed to be a close connection between internal stresses and elastic recovery, *i.e.*, heat treatment which removed internal stresses affected elastic recovery. In some stress-strain curves in the paper, relating to aluminium specimens, there was definite indication of elastic recovery following periods of creep. He asked whether the authors considered that that phenomenon, in the case of single crystals of aluminium, was connected with internal stresses in the crystals, and, if so, how those stresses arose and where they were situated? Mr. Bucknall also referred to a paper by Russian workers concerning the deformation of mild steel, in which it was stated that, in an aggregate of mixed grain size, slip occurred first, right across a batch of crystals of more or less similar orientation. Perhaps that phenomenon occurred in aluminium sheet of mixed grain size.

The President remarked that two days ago he had been able to use some of the data contained in the paper in solving a practical problem.

Professor Hanson, discussing the question as to whether or not a theory could be built up by working on single crystals and aggregates containing increasing numbers of crystals, said that it must be done, for it was the only way in which the problem could be tackled. No one imagined that single crystals would not behave differently from the aggregates, but it could not be known what happened to the aggregates until what happened to the individual crystals was ascertained. It must not be suggested that there was any doubt about the impossibility of doing it. Again, he saw no reason to believe that the nature of the metal within an individual crystal in an aggregate was any different from the nature of that in a single-crystal test piece, and until Dr. Rosenhain could show him that in fact it was, he would not believe it.

In reply to Mr. Jenkins, he said that Mr. Wheeler and himself had examined the interiors of the specimens, and that the inter-crystalline cracks went right through in many cases. The crack was sometimes very difficult to detect in its early stages, and he could not always say when the specimen began to crack from the surface. It was also true that in some cases a crack started as an inter-crystalline crack and later became trans-crystalline. Often that was due to the fact that breakdown started by the formation of inter-crystalline cracks, and as the cracks spread the rate of propagation of the fracture increased and, before very long, the phenomenon was not that of creep, but the normal tensile fracture. He did not wish to assume that aluminium behaved as other metals, and Mr. Wheeler and himself had not suggested that their results could be referred to any other metal. Dealing with Mr. Bucknall's point, he said he did not know where the internal stresses were.

(To be continued.)

Modern Methods of Raising Water from Underground Sources.*

By RUPERT S. ALLEN, Member, and W. E. W. MILLINGTON, Member.

BETWEEN the extremes of raising unwanted water from a mine to that of raising wanted water from a bore-hole, there are so many phases that to deal with even one method as applied to all these phases would be far beyond the scope of a single paper, especially if the term "modern" be applied to methods which, although of very early origin, are yet used to-day in up-to-date plants.

It is therefore the purpose of the authors, taking considerable liberty with the title of the paper, to concentrate upon pumping from bore-holes, but, even so, some further restriction is necessary to keep the paper within reasonable limits. For this reason and to avoid, so far as possible, invidious comparisons of the relative merits in one direction or another of the various types of pumping plants—which the authors felt they were not in a position to make with any degree of justification, being neither experienced in the application nor experts in the manufacture of all types—it was decided to confine the paper almost entirely to the centrifugal or turbine type of pump as applied to bore-hole work.

Introduction.—Since Nature decrees that the pump itself must always be practically at water level, the various methods of raising the water appear to fall into two main categories, namely:—

(1) The pumping plant and its means of driving, both placed below ground level.

(2) The pumping plant only placed below ground level, with the means of driving at the surface.

In the first, which is particularly applicable to mine pumping, and to some extent to wells of large diameter, whatever may be the type of pump, the electric motor is invariably the means of driving. It is in this field that the centrifugal or turbine pump, especially of the multi-stage type, is now so much employed for the following reasons:—

(*a*) Its suitability for direct coupling to a high-speed electric motor.

(*b*) Its low capital cost.

(*c*) The small space required for a pumping plant for a given duty—no mean consideration when accommodation for plant has to be hewn out of the solid rock below ground.

(*d*) Its low maintenance cost.

So much has already been written on this more or less normal design of centrifugal pump that more than this brief mention would seem unnecessary here.

The second of the main categories mentioned requires more detailed consideration, partly because the problem is more difficult and partly because, apparently—a word used advisedly—there is in it a greater possibility of change and improvement in the future.

Whilst a considerable variation of the water level can be dealt with in wells of large diameter, either by using motors of the submersible type or by enclosing the motors in "bells" or vessels which are kept filled with air at a pressure in excess of the water pressure on the outside, yet there are occasions when it is not desirable to have the driving motor coupled directly to the pump. In these cases the motor may be placed at the surface either with the pump fixed on girders below with a vertical shaft connecting it to the motor and a separate rising main, or with the bore-hole type of arrangement mentioned below.

Where only a comparatively small diameter hole exists from the surface to the water, and where the whole of the space available may be taken up by the apparatus itself, necessity demands that the apparatus should be of a type which can be lowered into position from the surface with no possibility of visual inspection afterwards.

For many years reciprocating pumps of various types and air lift plants have been used for this class of work, but during recent years the centrifugal or turbine pump has been largely developed for this purpose.

In general, from the point of view both of capital cost and of efficiency, the plants themselves are in the order of reciprocating, centrifugal, and air lift; but from the point of view of the quantity of water which can be obtained from a bore-hole of a given diameter the order is the reverse.

Reciprocating Pumps.—In cases where the running costs are of prime importance, it may pay to install reciprocating pumps, even though the capital cost is high, but it must not be overlooked that this type of pump in certain circumstances may require for a given quantity a larger bore than would be necessary for other types, and such an increase in the bore must be considered as an additional capital charge to be debited to the pumping plant.

In a paper entitled "A Description of the South Staffordshire Waterworks,"* Mr. F. J. Dixon gives a review of several reciprocating types of plants pumping from deep wells and bore-holes. Supplementing the information contained in this paper the authors are indebted to Mr. Dixon for the following table, giving the actual diameter of the different bore-holes and the rate of pumping from each:—

Name of station.	Total number of bore-holes.	Diameter of bore-holes. In.	Quantity pumped per bore-hole, gal. per min.
Ashwood	6	(2) 24	350
		(2) 33	790
		(2) 30	790
Brindley Bank	2	(2) 30	350
Maple Brook	4	(4) 36	700
Pipe Hill	4	(4) 30	700
Trent Valley	4	(2) 30	525
		(2) 30	700

These figures should not be taken as indicative of the relationship between the quantity pumped and the diameter of the bore-holes. Naturally a large-diameter bore-hole may at times be required to obtain the maximum "bleed" from the rocks, and this maximum may be such that it can be handled by a comparatively small pump. In such cases it follows that as the yield to the bore-hole is governed by external conditions, the type of pump installed can have little or no influence upon the quantity of water obtained. It is in those cases where the yield is unlimited that the plant which will give a maximum output for a given diameter of bore-hole is demanded.

Air-lift Pumps.—The air-lift plant for which claims for high efficiency are not made is simple, low in capital cost, and at the present time is capable of supplying a larger quantity of water from a given bore-hole than any other type. Since, however, it is necessary to introduce the compressed air into the water at a considerable depth below the actual pumping water level, a deeper bore than would be necessary with other types must be provided, and the cost of the extra boring should be charged against the plant when comparing relative merits of the various systems. In cases where in order to obtain the required "bleed" from the rocks, a bore-hole has to be made of such a depth that an air lift can be employed, then clearly the cost of this deep boring must not be considered as a charge against the pumping plant.

As being indicative of the increase in depth required for the satisfactory operation of an air-lift plant, the following figures, due to A. W. Purchas,* are quoted as representing a fair average:—

Lift. Feet.	Submergence. Feet.	Total depth of bore-hole. Feet.
25	100	125
50	150	200
75	175	250
100	200	300
150	255	405
200	275	475
250	305	555
300	300	600

In this table the "submergence" is the distance from the water level in the bore to the point of introduction of the air into the eduction pipe, and the "lift" is the distance from the water level to the point of discharge at the surface.

If the water contains sand or grit, the air-lift plant has decided advantages in its simplicity, but reciprocating pumps with valves having pliable seatings and present-day designs of centrifugal pumps rob the air lift of some of its advantages in this direction.

Centrifugal Pumps.—Although the application of the centrifugal pump to bore-hole work dates back more than a quarter of a century, it is only within the last few

* The Institution of Mechanical Engineers.

* "Trans.," Inst. Water Engrs., 1920.

* "Proc.," I. Mech. E., 1917.

years that development has been real, and it can therefore be said with considerable justification that this is the most modern method of raising water. Its growing popularity and its ever-increasing range of application provide sufficient evidence that this type of pumping plant can justify itself in actual use.

The main features of the problem from the point of view of centrifugal pumps in general may be set out as follows :—

(1) The pump itself has to be separated from, yet attached to and suspended from, the means of driving,

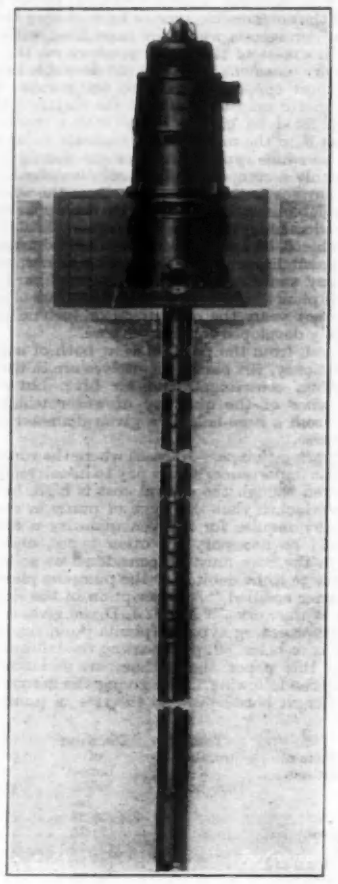


FIG. 1—CENTRIFUGAL PUMP

as in Fig. 1. The distance from the pump to the surface may be several hundred feet.

(2) The outside diameter of the pump has to be relatively small, and in general the quantity of water to be pumped would require a pump of normal design too large in diameter to pass down the bore-hole.

(3) At least two connections have to be made between the pump and the surface gear, namely, the pipe serving as a rising main and the shaft for power transmission. On occasions there may be a third, in the form of a shaft tunnel. Naturally, these connections are arranged

FIG. 2—STRAINER

concentrically, the driving shaft passing down the centre of the rising main.

(4) The rising main has to carry not only its own weight and the weight of the stationary parts of the pump, but also the load due to the weight of the water. The shaft has, in addition to transmitting the driving power, to carry the weight of the rotating parts, and often also a hydraulic load.

(5) The shaft has to be supported at intervals in bearings, which can only, in general, be water lubricated.

(6) As the pump can only be installed by being lowered into position in the bore-hole, it is essential that it should be built in suitable lengths for erection purposes. The designer must always have in mind the erection of a pump on site, since a trifling modification in design can save much time and effort during this process.

(7) As, sooner or later, a pump must be withdrawn

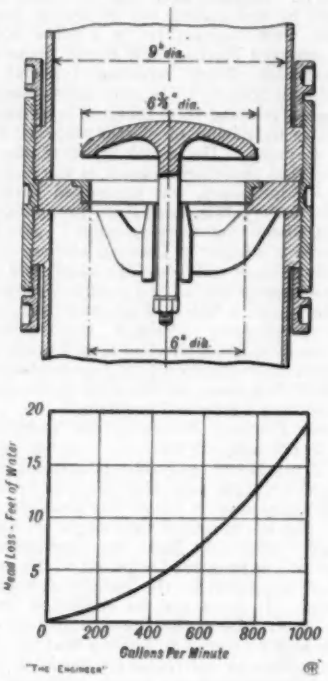


FIG. 3—FOOT VALVE AND LOSS OF HEAD

from its bore-hole, it is obviously essential that all parts should easily come apart. Too often one finds that parts which go together without difficulty in a works require more than gentle persuasion to come apart after being under water for some time. It is in this direction that actual experience counts for much.

(8) Owing to the weight of the rotating parts, considerable axial loads have to be dealt with by means of suitable thrust bearings.

(9) The water being pumped often contains sand and grit in suspension, making some form of protection for the bearings an essential feature.

Having thus outlined the salient features of the general problem as a whole, it is proposed to deal in some detail with the particular parts of the plant, following roughly the course of the water from the bore to the surface.

Strainers.—That a strainer of a type which will exclude solids too large to pass through the pump is necessary, goes without saying; but it is a debatable point as to whether more than this is necessary. It is clearly almost impossible to design a strainer which will exclude fine sand, and if there is any such sand in the water being pumped, some protection other than a strainer will be required for the bearings. If this further protection is provided, then it is not easy to follow an argument for the provision of an elaborate strainer; but, nevertheless, the tendency to-day appears to be to fit fine-mesh strainers. It cannot be said that such a strainer can do no harm, for should it become choked either the supply of water to the pump will be seriously decreased or the strainer will collapse owing to the pressure induced by the pump suction, this not being entirely unknown in actual practice. Further, there is a distinct danger of a bore-hole becoming silted up if the strainer restricts the passage of the sand, so that it cannot be discharged with the water.

Fig. 2 illustrates a strainer built up of suitably stiffened $^{1}/_{16}$in. perforated brass sheets with $^{3}/_{32}$in. diameter holes, having a total area of ten or twelve times that of the suction pipe.

Foot Valves.—Foot valves at the end of the suction pipe are usually not required, and may even be undesirable, though there are occasions when it may be advisable to fit them. Normally, a pump should be placed below the lowest water level ever reached when the plant is pumping —that is, it should be "drowned" at all times—but there are occasions when it may be desired to take full advantage of the pump suction effect. In such cases a foot valve is necessary in order to retain the pump in a primed condition, *i.e.*, full of water, so that it can be started when the water level is below the pump itself. It is, of course, just as essential that a bore-hole pump should not be run without being full of water, as is the case with ordinary pumps.

Again, a foot valve may be essential when pumps without shaft tunnels have to be installed, where the rest level is much below the surface, in order to retain water in the rising main to lubricate the shaft bearings during the starting process.

That a foot valve is not altogether desirable may be appreciated, since, first, it prevents the strainer from being washed out by the flow back of the water in the rising main each time the pump stops; and, secondly, in the event of the pump having to be raised, the rising main has to be lifted full of water, thus materially adding to its weight. These disadvantages may to some extent be surmounted by designing the foot valve with a relief or by-pass valve, operated by means of a wire passing up the bore to the surface.

A further disadvantage is that there may be a considerable and unsuspected loss of head in the passage of water through a valve of restricted size. In this connection, Fig. 3 shows such a foot valve, together with a graph of the results obtained from a test to determine the head loss across it. It will be noted that this loss is quite considerable.

Pumps.—In the pumps themselves, although the hydraulic problems are much as they appear in ordinary pumps, the restrictions imposed by the limiting outside diameter somewhat complicate them, and at the same time introduce certain mechanical difficulties. The problem of design has to be approached with the knowledge that the quantity of water to be pumped and the height to which it has to be lifted are known and fixed, as also is the permissible outside diameter of the pump. More often than not there is some margin available in the choice of speed, but it is required that the efficiency should be as high as possible, and the cost as low as possible. It is only natural in the circumstances that, as so often occurs in engineering, the best compromise has to be arranged.

Though not necessary, it is usual to build the pump in one unit placed approximately at the lowest water level in the bore-hole, all the stages through which the water

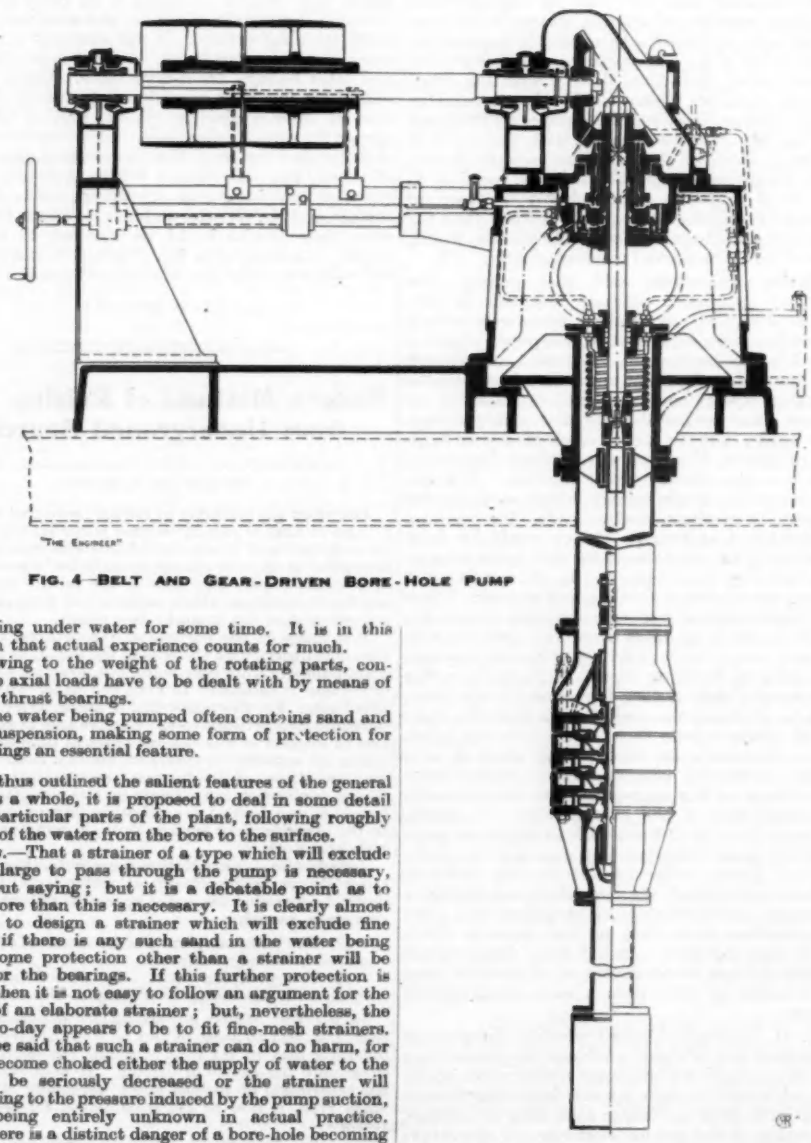


FIG. 4—BELT AND GEAR-DRIVEN BORE-HOLE PUMP

successively passes being bolted together so as to form a complete pump, similar to the one shown in section in Fig. 4.

Owing to the fact that the pump operates in a vertical position, it is permissible to build it up of more stages than would be possible in the case of a horizontal pump,

mainly because the weight of the rotating parts does not produce flexure of the shaft.

A considerable amount of the available diameter is required for the formation of the eye of the impeller, through which the whole of the water has to pass before energy can be transmitted to it by means of the impeller blades. Quite an appreciable amount is also required to provide adequate means for converting the high velocity

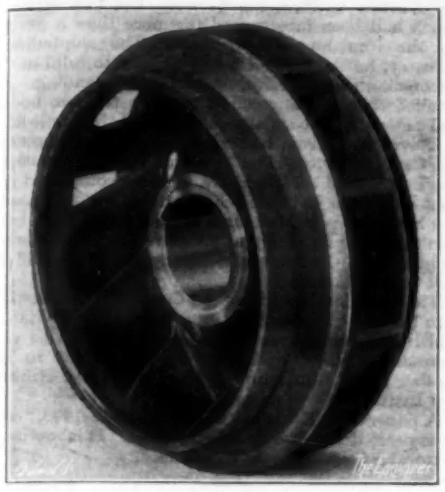


FIG. 5—SHORT-BLADE IMPELLER

of the water leaving the periphery of the impeller into pressure. The net result is that in all cases the impellers have to be of the short-blade type; that is of small outside diameter as compared with the eye diameter. Fig 5 illustrates one of these impellers.

The head per stage or per impeller is therefore inevitably small, in many instances being little more than 20ft.

Where there is a considerable difference between the

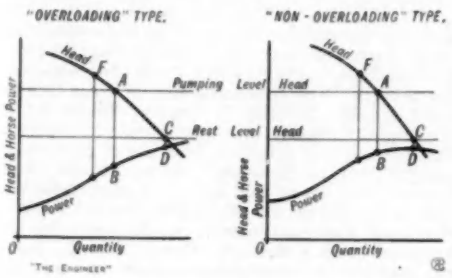


FIG. 6

rest level and the pumping level of the water, it is at times desirable, particularly in the case of A.C. motor drives, to consider impellers of the "non-overloading" or "self-regulating" type, as distinct from the ordinary or overloading type, with a view to preventing the demand for power exceeding the safe limit of the motor. Fig. 6 illustrates this point by a comparison of the two types.

In each case the head and horse-power characteristic

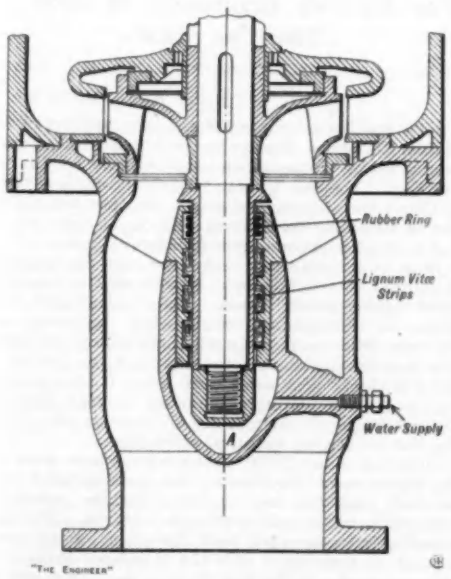


FIG. 7—TAIL-END BEARING

curves are plotted on a quantity basis, and the quantity and power at rest level are given by the points C and D respectively, and at the pumping level by the points A and B. It will be noted that the difference between the power points B and D is appreciably less in the case of the "non-overloading" type than in the other. The question might naturally be asked, Why should not the impellers always be of the "non-overloading" type? Apart from the somewhat debatable point as to whether the efficiency of this type is of necessity lower than that of the other, it is certain that a lower head per stage is obtainable, and consequently there is an increase in the total number of stages required and in the cost.

It should be pointed out that the "self-regulating" type has also a distinct disadvantage if a pump has for any reason to be operated at a reduced quantity by means of throttling. This will be seen from Fig. 6, for if the quantity has to be reduced from that represented by the point A to that at F the reduction in power is appreciably greater in the ordinary than in the "non-overloading" type.

Mechanically, the main difficulty is to secure water

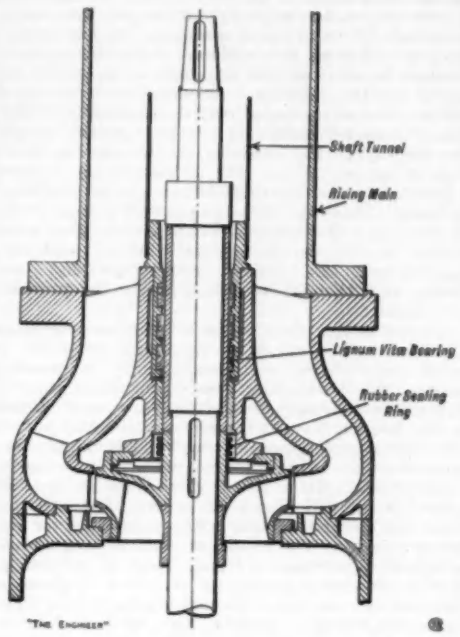


FIG. 8—PUMP BEARING

passages of low resistance, especially from one impeller to the next, as friction and eddy losses mean much when the total head developed per stage is so small.

Whilst the bearing at the tail end of the pump shaft presents little difficulty where the water is clean and a lignum vitæ bush can be used, it becomes more difficult when the water is laden with grit. As will be seen later, the bearings above the pump can in such cases be adequately protected by the provision of a shaft tunnel and a supply of clean water, but since the tunnel cannot be readily extended through the pump, some other means

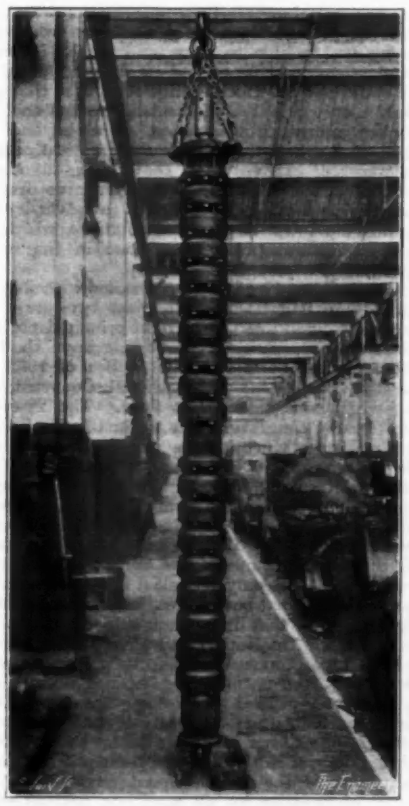


FIG. 9—MULTI-STAGE CENTRIFUGAL PUMP

have to be provided for the protection of the tail end bearing. Fig. 7 illustrates one design in which the bearing bush fits into a housing with a closed end. This bush, which is fitted with lignum vitæ strips, has also at the pump end a rubber ring. Into the space A a small supply of water from the shaft tunnel is led. The rubber ring, whilst allowing sufficient leakage of water into the pump suction to lubricate the bearing, maintains a pressure in the space A and along the bearing, thus effectively preventing any leakage of the gritty pump water along the bearing.

When a shaft tunnel is used, a similar rubber ring device is usually provided—as shown in Fig. 8—at the pump end of the bearing immediately above the pump, in order to keep down the leakage of tunnel water at this point to a minimum.

Although, as previously stated, many stages may be built together in a vertical pump, there is, for mechanical reasons, a limit to the number which can be formed into a complete unit without some intermediate bearing. Such an arrangement is illustrated in Fig. 9. Here, again, with clean water there is not much difficulty, but if the water contains grit a design similar in principle to that of Fig. 7 must be employed, a supply of tunnel water being used to lubricate the bearing and to prevent the ingress of grit.

The mechanical balancing of the rotating parts is a question about which there has been much discussion, especially as to whether they should be balanced dynamically as a whole. Since each of the rotating parts is short in an axial direction, the whole of the parts may therefore be taken as being made up of a number of comparatively thin discs. If each of these parts is separately balanced statically, then the whole should be in balance both statically and dynamically. If, on the other hand, dynamical balancing of the whole were relied upon, it is quite possible to have the impellers, for example, out of balance in themselves, and in the event of an impeller being replaced by a spare impeller a state of unbalance might arise, necessitating a rebalancing of the complete whole. The authors are therefore of the opinion that each rotating part should be individually balanced. The case is very different from, say, the rotor of an electrical machine, which has to be treated as a whole and always remains the same whole.

(To be continued.)

Institution of Naval Architects.

No. I.

THE Spring Meetings of the Institution of Naval Architects were held in the rooms of the Royal Society of Arts, John-street, Adelphi, London, on Wednesday, Thursday, and Friday, March 25th, 26th, and 27th, under the presidency of Admiral of the Fleet the Right Hon. Lord Wester Wemyss. The first business on Wednesday morning was the presentation of the annual report of the Council for the year 1930, which was read by the Secretary, Mr. R. W. Dana, who added that the Royal Society of Arts, under the terms of the Thomas Grey Memorial Trust, offered a prize of £100 for an essay on the stability of ships, with special reference to the particulars which should be supplied by shipbuilders, and also to the value of any mechanical devices for ascertaining the M.G. Applicants were asked to communicate with the Secretary of the Royal Society of Arts.

The adoption of the annual report and accounts of the Institution was proposed by the President.

ANNUAL REPORT OF THE COUNCIL FOR 1930.

The total membership of the Institution shows a net increase of 70 in comparison with the previous year. While the losses through death and resignation amounted to 140, the number of candidates elected at the Spring and Summer Meetings was 210. In view of the continued depression in the shipbuilding industry the above result may be considered satisfactory.

Since the last annual general meeting the Institution has suffered through the death of many notable members, whose loss is deeply regretted: His Grace the Duke of Northumberland passed away last summer at an early age, after a brief illness. He will be remembered with admiration and affection by all the members of the Institution over which he presided with such conspicuous success from 1921 to 1928; the Hon. Sir Charles Parsons, O.M., K.C.B., F.R.S., the foremost engineer of his day, whose practical genius contributed so much to the advancement of British engineering; Sir William E. Smith and Mr. A. E. Seaton, two of our most prominent Vice-presidents, who had given most valuable services on the Council for many years past; Mr. Andrew Laing, Vice-president, and Sir Archibald Ross, K.B.E., Member of Council, who were among the foremost marine engineers in the country; Colonel N. Soliani, R.I.N., Honorary Member, who had formerly designed some of the finest warships in the Italian Navy, and had been a member of the Institution for over forty-six years; Monsieur A. C. E. Rateau, the designer of the well-known turbine bearing his name, and a very distinguished French scientist; Mr. C. H. Jordan, formerly of Lloyd's Register and the last survivor of the original members of the Institution, and Mr. John Hamilton, of Dalmuir, who had been a member of some sixty years' standing.

The annual statement of receipts and expenditure, duly audited, shows a satisfactory financial position. The Council regrets to report that its appeal to the Special Commissioners of Income Tax for exemption from taxation, referred to in the last Annual Report, was unsuccessful. A number of such cases affecting the principal engineering institutions have now been heard, and while the Commissioners have granted exemption to four out of seven of these institutions, they have refused exemption to three. In view of the great work done in the cause of education, research, and of general value to industry by these societies, it is regretted that the Commissioners should not have found it possible to relieve these bodies from the burden of taxation.

A most successful Summer Meeting was held in Liverpool last July, attended by a large number of members and ladies, who were most cordially received by the Civic authorities and the leading citizens of Liverpool. Visits were paid to the docks, shipyards and engineering works in the neighbourhood, and great hospitality was shown by the Lord Mayor of Liverpool—Councillor Lawrence Holt—Sir Frederick Bowring, the Mersey Docks and Harbour Board, and the directors of the leading shipping and shipbuilding and engineering companies.

By the kind invitation of the Association Technique Maritime et Aéronautique, of Paris, a Summer Meeting is to be held this year in Paris from June 29th to July 3rd, to be followed by a visit to the Chateaux of the Loire and the shipyards of St. Nazaire. This meeting will be held jointly with the Association Technique, and a cordial welcome is assured to all those who are able to take part.

The William Froude Laboratory Yarrow Tank continues to render valuable service to the shipping and shipbuilding industries, both by the private tests carried out for individual firms and by the research work which furnishes year by year the data by which much new light is thrown on problems in naval architecture. The Government made an important contribution last year to this branch of research by guaranteeing the cost of the construction of a new tank, somewhat longer, but narrower

than the existing one, which is now under construction, and which will, when completed, give additional facilities for dealing rapidly with the testing of new designs, and supplementing the facilities for research work. The Council trust that shipbuilding and marine engineering firms will liberally support the research fund, which is at present unable to meet its annual expenditure out of revenue.

The first award of the Duke of Northumberland Prize was made to Mr. Laurence Barton Hislop, of the Royal Technical College, Glasgow, on the result of the examination for the Higher Certificate in Naval Architecture.

Mr. Francis Henderson, in seconding the report, commented on the very satisfactory financial position of the Institution, and said that although there had been a handicap owing to the acquisition of new premises, the position was solving itself, and the members were satisfied that the Council's action in that respect was right. With regard to membership, he said that the Institution lost about 160 members every year through death, resignation, and removal, and it was up to the members to ensure that new members were introduced regularly. It was desirable to secure about 200 new members every year. The report was unanimously adopted.

The Premium for the past year was formally presented by the President to Dr. J. Lockwood Taylor, to whom it was awarded for his paper on "Vibration of Ships."

President's Address.

The President congratulated the members of the Institution at the opening of this the seventy-second session on its continued growth and relative prosperity. It was a satisfactory and notable achievement in the history of the Institution, he said, that notwithstanding the deplorable depression through which the shipping and shipbuilding industries of the country were passing, the Institution should be able to show a satisfactory balance sheet, not only in financial matters, but also in what was even more important, the intellectual and social side. It could fairly be claimed that the papers and discussions embodied in the Institution's "Transactions" had maintained a high level, and that the industry appreciated what the Institution had done to keep scientific research in the forefront of British shipbuilding progress. The respect in which its proceedings were held by all those concerned with the construction of ships throughout the maritime countries of the world was a testimony to their worth.

Referring to the losses which the Institution had sustained during tho past year by the death of many of its most prominent members, the President said that in the Duke of Northumberland the Institution had had a noble and energetic leader, who had carried out his duties loyally during seven years of office as President, and his outstanding qualities of mind and character had done much to enhance the prestige of the Institution's meetings at home and abroad. It had been a great loss when that able representative of a long line of distinguished ancestors was, in the prime of life, cut off from further service to his country, to whose interests he had devoted all that loyal patriotism which filled his mind and soul.

The President also paid a tribute to the late Sir Charles Parsons, in whom we mourned one who had sprung from a family rich, not only in tradition, but in scientific ability, and who had by his genius opened up a new phase in the history of engineering, and had created an industry of world-wide application. From his early days at Cambridge, Sir Charles had, with characteristic energy and resource, surmounted one by one all the obstacles which the inertia of indifference, on the one hand, or the severity of competition, on the other, had at different times placed in his path when developing the steam turbine. His fertile brain, needing fresh worlds to conquer, had also devised in quite other fields of research a number of brilliant and practical solutions to problems which had baffled the efforts of all others before him. It would be difficult to overestimate his loss to the engineering world, but his many friends would remember with feelings of genuine gratitude the debt they owed to one who, with all his higher knowledge in the realms of science, retained a real simplicity of heart and the great gift for friendship.

Dealing with the acute crisis through which the shipbuilding industry is passing, the President said it was true that the tonnage launched from British yards during the past year, namely, 1,478,500 tons, represented over 50 per cent of the total world tonnage launched, so that, measured by tons alone, the year 1930 would appear in a relatively favourable light. Against this, however, lay the fact that in regard to work now in hand and orders ahead, the situation was very different. Of the tonnage launched last year in this country no less than 650,000 tons, or 44 per cent., was for foreign owners, and that was more than twice as high a percentage as in the last few years. Of the total launched, 760,000 tons were for motor ships, a total which exceeds the corresponding figure for steamships. The largest of these motor vessels was the "Warwick Castle," of 21,000 gross tons, whilst the largest turbine steamer was the "Empress of Britain," 42,000 gross tons. Both these ships were the biggest launched anywhere during 1930. For the carriage of oil in bulk seventy-seven ships, totalling over 555,000 tons, were launched, representing over 37 per cent. of the grand total. The increase in tanker tonnage had been one of the features of the last few years in shipbuilding returns, and British shipbuilders were still supplying over one-third of the world's output of that class of ship. In marine engines also one-third in indicated horse-power of the world's total was under construction in British engine shops, but the larger proportion of that was for turbine and reciprocating steam engines. So far, therefore, as our relative position was concerned, we might fairly claim to be holding a high place in the world's workshops, and as regarded workmanship and efficiency we might take credit for maintaining a high standard of excellence. On the other hand, it was obvious that our activities in relation to our capacity for output was sorely restricted by the present shrinkage in the world's demands for ships and engines. Since 1930 a rapid decrease in orders for new ships had set in, and by the end of last December that decrease had risen to over 650,000 tons, as compared with the beginning of 1930, almost a record decline in our shipbuilding annals. On the Clyde, for instance, the tonnage in hand represented only 60 per cent. of the tonnage in hand a year ago, and other shipbuilding centres had fared no better. That state of things was fully accounted for by the slump in trade and freights, which had made owners unwilling to place orders while so much tonnage was lying idle. Indeed, shipping had fared worse during 1930 than at any time during the previous ten years.

Unfortunately, the decline in merchant shipping coincided with a period of significant reduction in naval programmes, and consequently in warship orders. The Washington Treaty, which had imposed such a drastic cutting down of our Navy, was followed by the London Naval Conference, which had put off still further any hopes our shipbuilders might have entertained of an immediate expansion in our naval requirements. To a naval officer such as himself, trained in the old blue water school, that situation could not but be fraught with grave risks for our future security. The reduction in naval programmes so joyfully proclaimed in certain quarters was helping to swell the unemployment returns and to deplete the resources of our shipyards and engine works. The Royal Dockyards, naturally, had the first claim to such work as was obtainable. Private yards, therefore, were feeling the full measure of the depression. While world conditions were partly accountable for our difficulties at home, shipbuilding, in common with others of our basic industries, was heavily handicapped in the struggle for existence by the high taxation with which it was burdened. In competing for orders against foreign countries, we had not only to bear higher labour costs and overhead charges, but also taxation far higher than that borne by our competitors. It grew year by year more menacing and created a vicious circle from which it was difficult to escape, for much of the money raised was spent on non-productive services. Some of that expenditure would be admirable if the financial situation warranted it, but at present it imposed a burden which the industry was unable to bear, and meant increased unemployment and its attendant dangers and evils.

He could not help feeling, however, that the spirit of British enterprise which was being stifled and held under by many circumstances, some beyond our control, and others due to a faulty political orientation, was still existent, and that, given favourable opportunity, we should at once again give proof of those sterling qualities of courage in adversity and natural bent towards practical solutions which our people had shown more than once in the earlier chapters of our "rough island story."

In the domain of legislation connected with shipping affairs, there had been in the past two years two important conventions at which the principal maritime nations were represented. Following upon the Convention for the Safety of Life at Sea of 1929 had come the Load Line International Convention of 1930, which was signed last July. The President offered hearty congratulations to Sir Charles Sanders and Mr. Foster King for the part they had played in bringing about a satisfactory solution of that difficult problem, and getting the representatives of many nations to be of one mind upon a subject of such importance to the shipping industry. In papers to be presented by Sir Charles Sanders and Mr. Foster King during the course of the Spring Meeting there were included, not only technical descriptions of the measures which had been taken, but also some of the early history of that important subject, and of the part which the Institution had played in arriving at the Load Line Convention by focussing public attention upon it, and encouraging detailed investigation into that many-sided problem. The Conventions awaited parliamentary ratification, but that would doubtless follow, and already some of the provisions for the safety of life at sea had been put in hand in anticipation of their enforcement next year. Uniformity of practice by all maritime nations would tend to ensure not only greater security of life and the safe transport of cargoes, but also, what was of great importance to the future of our shipping prosperity, equal conditions for all and the elimination of unfair competition.

Invitation to Visit Germany.

The secretary read a communication from Dr. Schütte, the President of the Schiffbautechnischen Gesellschaft of Berlin, extending on behalf of that body an invitation to the Institution of Naval Architests to hold a Summer Meeting in Germany at a date which would be convenient to both bodies. Dr. Schütte had intended to be present at this Spring Meeting in London, but was unable to do so owing to illness, and the Society was represented by Dr. Teubert. Dr. Schütte, in his communication, extended to the members of the Institution the congratulations of their German professional colleagues, and said he was glad to be able to take part in restoring the friendly connections between the two societies which had been interrupted for more than a decade by the iron hand of destiny. The shipbuilding industry, he stated, had a special task to fulfil in the restoration of a healthy, mutual understanding. He recalled that the connection between the two bodies had prospered so cordially that in 1913 the Institution of Naval Architects had nominated his predecessor, Dr. Carl Busley, as Hon. Member. In the meantime, Dr. Busley had died, and Dr. Schütte considered it a debt of honour to render thanks to the Institution in the heartiest possible manner. He hoped that by a joint meeting in Germany the co-operation between English and German shipbuilding science would be still further increased.

The President said that the Council of the Institution had in principle heartily accepted the invitation which had been extended to the Institution to visit Germany. He extended a hearty welcome to Dr. Teubert, and asked him to convey to Dr. Schütte the Institution's heartiest thanks.

A paper on "British Sea Power, 1900–1930," was then presented by Sir Archibald Hurd. It is reprinted in an abridged form on Page 353.

The annual dinner took place on Wednesday, March 25th, at the Connaught Rooms, and the chair was taken by the President of the Institution, Admiral of the Fleet the Right Hon. Lord Wester Wemyss. About 530 members and guests were present. After the loyal toasts had been duly given and honoured, the toast of "The Royal Navy" was proposed by the President, who referred to recent reductions, and said that there were many who believed that in view of the duties which had to be performed by the Services they were not justified. The reply was made by Admiral Sir Cyril T. M. Fuller, K.C.B., Second Sea Lord and Chief of Naval Personnel, who said that the modern ship made a higher claim on the personnel than ever before, but that claim was being met by both officers and men. The toast of "The Mercantile Marine" was ably proposed by Mr. Maurice E. Denny, Master of the Worshipful Company of Shipwrights, who said that, although we had struck a bad patch in both the material and psychological realms, he was of the opinion that, given fair play and reasonable competitive conditions, we might look forward to a time when our merchant marine would again be predominant. Sir Charles C. Barrie, K.B.E., replied and spoke from the shipowner's point of view. The toast of "The Institution of Naval Architects" found a genial proposer in the person of his Excellency the Netherlands Minister, Jonkheer Dr. Marees van Swinderen, who referred in a witty speech to the onerous Suez Canal charges. Lord Wester Wemyss made a brief reply.

(To be continued.)

The British Economic Mission in the Far East.

Professor C. A. MIDDLETON SMITH, M.Sc., M.I. Mech. E.

Hong Kong, March 4th.

During the last three months the members of the British Economic Mission to the Far East have been accumulating impressions and experience in the Far East. They have visited the chief centres of trade in China and Japan, and as I write they are on the eve of returning to Britain. No doubt their report will be published soon after their arrival home.

It is unfortunate that there was only one engineer appointed to the Mission. Nearly all the members were "piece goods" men. The cotton trade with China is diminishing rapidly—the Japanese and Chinese mills can undersell Lancashire products. The engineering trade is the one hope for Britain in the Far East. Yet there were many cotton experts and only one engineer included in this Mission. Colonel Reginald Morcom did all that one man could do, but he needed technical colleagues.

Although many public speeches have been made by the members of the Mission, the most valuable part of their work has been accomplished by means of visits to factories and by private inquiries. The outstanding impression left upon the writer's mind, after several conversations with the members during the last two weeks in the Far East, is this—they are all impressed with the enormous possibilities for engineering developments in China. Since that is a text upon which the writer has based many speeches and contributions to the Technical Press for the past eighteen years, it was naturally pleasant to hear these views expressed by men mostly interested in the piece goods trade.

The Labour Conditions.

The next impression is that the members were all astounded at the poor labour conditions, wages, &c., in

Japan and China. It was obvious that the trade union members of the Mission were thoroughly alarmed at the conditions under which they saw industrial workers labouring in both countries. They must realise now that production costs in Great Britain must come down if home manufacturers are to compete in Far Eastern markets. They continued to talk about the low standard of living of the industrial workers in China and Japan. They declared, in public speeches and in private conversations, that under no circumstances would they agree to any lowering of the standard of living in Britain. But they cannot maintain that standard unless the export trade is increased. "If we can't get the Far Eastern trade in competition with cheap labour without reducing the standard of living in Britain, then let us do without it," was a sentiment which they frequently expressed. But they invariably added that there seemed to be great possibilities for British engineering products in China.

Static and Dynamic China.

They have probably realised that, as the Far East is gradually becoming mechanised, so must the articles of trade change. It is also reasonable to suppose that, just as the standard of living rose in Great Britain with the introduction of machinery, so will it improve in the Far East as modern methods of production are adopted. It is certainly higher in Hong Kong than in China.

It was recently stated in a broadcast address in England that the great event of the twentieth century was not the Great War, but the awakening of Asia. The greatest change in the world to-day is the catapulting of China into the industrial era. It is suddenly changing from forty centuries of static civilisation to one that is dynamic. Eighty years ago the one article of export from China was tea; now she also exports soya beans, silk, &c. It is inevitable that piece goods will be manufactured in mills in the Far East, but machinery for all sorts of purposes will be and now is being imported. Shanghai, Tientsin, Hong Kong, and Canton are expanding industrial centres.

During the last thirty years various British firms in Lancashire have been sending quantities of textile machinery, power-producing plant, and electrical equipment to Japan and Shanghai. That machinery, and tariff increases, must have its effect upon the piece goods market in the Far East. Recent figures published by the Government of Hong Kong show an astonishing decline in this trade between Britain and Hong Kong. Japan is now the big exporter to China, but soon there will be only home-made goods in the Celestial Empire.

The Demand for Power.

The simple statement that during last year the Shanghai electric power plant was sold for several millions of taels, then the equivalent of £10,000,000, tells its own story. For Shanghai, with its quarter of a million factory workers, now has the power load of a modern industrial city. It is inevitable that the load will continue to grow, for mechanisation has been proved to pay. During a recent visit to that amazing centre of industry on the Yangtze River, the writer saw any amount of evidence of the rapid increase in factories with modern equipment. Not only were there many well-equipped textile mills, but up-to-date chemical works, tobacco factories, flour mills, canning establishments, cold storage warehouses, and other varied plants.

The most surprising of all was a factory in which the mass production of matches was taking place with every labour-saving device that could be imagined. The writer was told that less than a hundred "hands"—they seemed to be nearly all women and children—were turning out close on a quarter of a million boxes of matches a day. It is probable that the average wage, at the present rate of exchange, was 4d. for a nine-hour day—say, a ½d. an hour. The machinery must have cost a good deal. That factory is merely one example of the industrial development of Shanghai. In Tientsin, Hong Kong, and Canton, new factories are springing up and old factories are enlarging their plant. In Hong Kong they are making crepe rubber-soled shoes that sell—at the present rate of exchange—for about 1s. The same type of shoes is being sold, local merchants say, at 4s. 3d. in England.

Some Big Orders.

It is obvious that big orders for machinery must have been placed in connection with the Shanghai power plant, the many textile mills, and factories of all sorts in Shanghai and other industrial centres in the Far East.

A few days ago the writer visited a cement works in Hong Kong. A British firm has supplied an extension of plant—the order was worth about a quarter of a million sterling. Valuable orders for new plant have been placed in connection with electric supply in Hong Kong. Nor must we forget that all of the many motor omnibuses used for transport in a Colony of a million people are of British make.

There is a Canadian firm, working in connection with a British engineering concern, that is convinced of the practicability of a hydro-electric plant about 190 miles from Hong Kong, in the interior. The engineers say that 50,000 horse-power can be obtained from the "white coal" available. It is only 100 miles from Canton. That city is the centre of a large industrial area. There will certainly be a great deal of mechanisation in and around Canton in the near future.

The last ten years have witnessed the transformation of Canton, a city 90 miles up the river from Hong Kong. When the writer first visited that city, nearly twenty years ago, it astounded him. After his visit he wrote: "It is a city of two million people without a wheel." There was then no sign or symptom of dynamics—not even the man-power rickshaw which you could then see in every coast port from Colombo to Yokohama. A great transformation has since taken place. To-day, Canton has its wide roads, its modern system of traffic control, its motor omnibuses, its automatic telephones, its radio services and its efficient Public Work Department.

One hundred years ago there was foreign trade in China only with one port—Canton. Just as that tiny stream of foreign trade has spread itself all over China—in every village of this nation of 400,000,000 people, you can purchase imported kerosene and cigarettes—so will the demand for machinery spread from Shanghai, Tientsin, Hong Kong and Canton to all parts of the country.

The Bank and Engineering.

As evidence that "old China hands" are at last aware of the fact that the market in China is changing—it might almost be said "has changed"—from piece goods to machinery, it is worth quoting from a speech made in Hong Kong to-day by the chairman of the premier financial institution in the Far East—the Hong Kong and Shanghai Banking Corporation. He said: "In engineering products there has been a certain demand for textile and electrical equipment, in the supply of which British manufacturers appear, I am glad to say, to be holding their own, in spite of the difficulty of meeting foreign prices. Industrial development as a whole is receiving close attention in China in both official and private circles, and I think it is safe to say that, given the benefits of peace, it will go ahead rapidly, carrying with it a steady demand for imported machinery and equipment. The same applies to the railways, which are crying out for rehabilitation of the existing lines and for constructional progress. I shall refer shortly to the plans for devoting the British Boxer Indemnity funds to this purpose. Aviation, meanwhile, is progressing and a substantial number of aeroplanes for both civil and military use were imported in the course of the year. The Shanghai-Nanking and Hankow services have functioned regularly and plans are said to be complete for the operation of an air line to Berlin, *vid* Siberia, under Sino-German management. In the supply of aircraft, as of motor cars, American firms retain a decided lead."

China a Price Market.

It is probably not realised that a great deal of the ocean-carrying trade in the Far East is in the hands of British shipping companies. A large number of vessels built on the Clyde, and in other British shipyards, work between Far Eastern ports. One British company alone must have nearly 100 steamers in the trade. In Hong Kong and Shanghai there are well-equipped dockyards for repairing ships of any size. The new "Empress of Japan" was recently docked in Hong Kong. These establishments are mostly furnished with British machine tools, electrical gear, steel, &c.

It is, however, with the problem of exporting machinery to the Chinese buyer that we are mostly concerned. The Chairman of the Hong Kong General Chamber of Commerce recently asserted to the British Economic Mission that "China is a price market." In this connection the following prices c.i.f. Hong Kong were quoted by a German firm in English currency for two-stroke Diesel engines:—

B.H.P.	Price of German engines, c.i.f. Hongkong. Price.
240	£1635
120	805
90	615
60	435
30	270
20	182

A British firm gave the following quotations c.i.f. Hong Kong for the same type of engine:—

B.H.P.	Price.
130	£1300
72	950

The relative prices for mild steel, for machine tools, and for high-powered motor cars are about the same. The chief competitors of the British in China in engineering products are German, American, Swedish, and Swiss firms. It is noticeable that German, Swiss, and American firms send out very complete catalogues in the English language and with prices in English currency. Local British merchants complain that the "home" firms do not send out sufficient literature and do not expedite deliveries. Above all, they complain about prices.

The New Demand.

It is very little use telling the Chinese buyer that British machinery is of better quality. That does not interest him. He wants a low price and quick delivery. The demand in China is for power plant, factory equipment—textile machinery, &c.—electrical gear, machine tools, motor cars, and aeroplanes.

There is a determined effort to increase communications. The British Boxer indemnity money will enable British firms to obtain good orders for railway materials. It may also lead them to make a bid for other orders. In South China we are particularly interested in the statement that the Boxer money will be used for completing the 600-mile railway that is to connect Hankow with Canton. This must have a stimulating effect on industrial development in the productive province of Kwangtung, an area of the size of Britain, rich in natural products and inhabited by a very industrious and intelligent population. Recently there has been a great deal of road construction in these Southern Provinces. These roads and the many waterways will act as feeders to the new trunk railway line.

The Chinese Student.

There is one matter that must be mentioned in this connection. It is the difficulty that those of us in China who wish to see the country developed have in placing Chinese engineering students in the workshops of Britain. It is so obvious that these young men will become good salesmen for British goods that it seems simply stupid that firms do not encourage them to go to Britain.

Without wishing in any way to anticipate Colonel Morcom, or the Report of the Economic Mission, it may be explained that this aid to British trade has been repeatedly urged by the writer since the Armistice in 1918. Yet in spite of the endless correspondence with firms, and with trade organisations in Britain, there are no properly organised arrangements. Some engineering graduates from China have gone to England, but it has been very difficult to place them.

Sir Thomas Allen, in his farewell speech in Hong Kong, made the following statement—the sort of sentiment that is approved of in a Crown Colony:—"We have heard it said," he exclaimed, "that others have done things we have neglected to do, and that others have done things that we are incapable of doing; but I will not, as a Britisher, admit that for one moment. Any task that has yet been within the reach of human achievement is the Britisher's job. . . . . While we were busy making the world safe for humanity others were busy capturing our markets. While we are paying our debts on the one hand and forgiving our creditors on the other, tariff doors have been slammed in our face, making our goods dearer in the world's markets than they otherwise would have been."

British firms need have no doubts concerning the desire of those of their own people who live in the Far East to help in the solution of the industrial problems that worry them. We are actuated by two motives, of both of which we are unashamed. They are, firstly, the conviction that it is essential for the welfare of the Chinese people that law and order shall be restored in their country and that the standard of life shall be improved. Only engineering development in China can do that. Secondly, that there shall be a great reduction in the unemployment figures in Britain. A great demand for machinery in China will help that.

It is to be sincerely hoped that the British Economic Mission in the Far East will issue a report that will influence those in authority in Great Britain to bring about these benefits to the Chinese and to their own people.

BOOKS RECEIVED.

The Chemical Technology of Steam-raising Plant. By H. N. Bassett. London: Ed. Arnold and Co., 41, Maddox-street, W. 1. Price 12s. 6d. net.

A Monograph on Viscometry. By Guy Barr, B.A., D.Sc. London: The Oxford University Press, Amen House, Warwick-square, E.C. 4. Price 30s. net.

Year Book of the Scientific and Learned Societies of Great Britain and Ireland, 1929–30. London: Charles Griffin and Co., Ltd., 42, Drury-lane, W.C. 2. Price 18s. net.

Simplified Calculation of Statically Indeterminate Bridges. By G. G. Krivoshein. Czechoslovakia: G. G. Krivoshein, Bubenec, Buckova 27, Prague. Price 5·00 dollars.

Arbeitsweise und Wirkungsgrad von Windsichtern. Von P. Rosin und E. Rammler. Berlin: V.D.I. Verlag, G.m.b.H., Dorotheenstrasse 40, N.W. 7. Price 1 mark.

Das Mitreiben von Wasser aus dem Dampfkessel. Von Dr.-Ing. Heinrich Vorkauf. Berlin: V.D.I. Verlag, G.m.b.H., Dorotheenstrasse 40, N.W. 7. Price 5 marks.

The Purification and Disposal of Sewage. By G. J. Nurse, A.M.I.S.E. London: Crosby Lockwood and Son, Ltd., Stationers' Hall-court, E.C. 4. Price 4s. 6d. net.

A Guide to the Public Works Facilities Act, 1930. By F. N. Keen, LL.B., and H. Royston Askew, B.Sc. London: Stevens and Sons, Ltd., 119, Chancery-lane, E.C. 4. Price 10s. net.

Waterworks for Urban and Rural Districts. Second edition. By H. C. Adams. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 15s. net.

Industrial Rotherham: Its Economic Resources, Industrial Activities, and Sites for Development. Rotherham: The County Borough of Rotherham Development Committee.

A New Rail Brake.

THE latest development in hump yard operation is the eddy current brake made by the Westinghouse Brake and Saxby Signal Company, Ltd., of 82, York-road, King's Cross, London. That a braking effect can be produced by eddy currents in a metal disc revolving in a magnetic field has been known for many years, but the possibility of utilising this eddy current effect for the purpose of retarding railway wagons was first realised by Drs. Baeseler and Thomas, who, in 1925, produced an eddy current rail brake which was shown at the Transport Exhibition held in Munich in that year. Subsequent experiments led to the design of another eddy current brake, which was installed at Magdeburg in November, 1928, and this brake has been in operation day and night ever since. From tests carried out on the brake while in actual operation, useful information was obtained, and as the result of this the improved brake, which is being supplied by the Westinghouse Brake and Saxby Signal Company, and which was demonstrated at the company's Chippenham works on Tuesday, March 24th, was evolved. A plan of, and cross sections through, a double rail brake are shown in Fig. 1, from which it will be seen that brake beams A extend through the whole length of the retarder and are supported at intervals by core pieces B, which rest on the cores C of electro-magnets. The beams A are capable of limited movement towards, or away from, the running rails, this being made possible by hinges E, whilst springs F constrain the movement and return the beams to their normal position when the brake is unoccupied. Foundation bolts hold the magnet rigidly on the concrete foundations. The poles between which the wagon wheels run, consist of bars G, which normally project above the beams A, and as a certain amount of wear on the parts actually in contact with the wheels is inevitable, separate wearing strips H are attached to the bars G in order to make replacement as simple and inexpensive as possible. If it were not necessary for locomotives to pass through the brake, the bars G might be rigidly fixed to the beams A, but as locomotives might foul the bars in this position, provision has been made for lowering the bars into a position in which their tops are on a level with the upper surface of the beams A. For this purpose the mechanism shown in the upper part of Fig. 1 is provided. At intervals the bars are attached to blocks, which slide in sloping guides J, fixed to the brake beams A, and raising or lowering is effected by pushing or pulling the bars horizontally by means of a rod K, operated by a motor L through gears and the screwed shaft M.

This is the only mechanically operated part of the brake, the actual moving parts being the bars G, and as this movement plays no part in the braking action, the process of braking may be said to be achieved without any movement of the parts other than the brake beams A in adjusting themselves to the slightly varying thickness of the wheel tires. The overall length of the standard retarder is 50ft., and a double retarder of this length is fitted with twelve magnets, or six per rail. As shown in the drawing Fig. 1, the magnets are mounted horizontally immediately beneath the rail, the windings being impregnated and enclosed in a sealed sheet metal case, with sealing compound, which renders the whole structure absolutely water-tight and failure as the result of the track becoming flooded is not, therefore, likely to be experienced. Channels are provided in the reinforced concrete foundation for the purpose of drainage and for laying the cable. The magnet cores and the brake beams A are composed of sheets of steel, which are riveted together, while the core pieces connecting them consist of plates loosely held together and hinged to both the brake beams and the magnet cores in the manner described. This loose construction permits of the movement of the brake beams necessary to allow for varying wheel tire thicknesses, while, owing to the attractive and binding action of the magnetic field produced, which holds the plates firmly together, no rattling and consequent wear can occur during operation. If desired, the brake can be mounted on a wooden foundation, which, besides being cheaper than concrete, can, if the necessary preparations are made beforehand, be put into place during a slack period. The foundation is laid on about 10in. to 1ft. of ballast and consists of a framework of sleepers lying close together. On this framework stout oak baulks are laid lengthwise and they carry the sleepers for the track rails, the poles of the magnets being fastened by special wooden supports to the longitudinal baulks.

When the magnet windings are energised before the wagon wheels enter the brake, a magnetic flux is set up round the cores, through the core pieces, and across the gap, and tends to draw the brake beams together. The springs F, however, restrain the moment of the beams, and it is only when the wagon enters the brake that the magnetic circuit is completed through the wheel tires. Owing to the change of reluctance brought about by the introduction of the magnetic material of the wheel tire, there is a tendency for a great and sudden increase of the flux, but, owing to the rotation of the wheels, this is opposed by the setting up of eddy currents in the tires and brake beams and it is the interaction of these eddy currents and the magnetic flux that produces the braking effect. When the wheels enter the brake, on account of the great magnetic attraction, they are gripped by the brake beams, and a certain amount of friction occurs. A portion of the braking effect is, therefore, purely mechanical, but it is only in the neighbourhood of about 20 to 30 per cent. of the total effect. In consequence of the fact that when the wagon enters the brake the building up of the flux is delayed, the wagon always enters the brake perfectly smoothly, irrespective of its speed or weight. The strong magnetic field passing through the wheel tire tends to bind the wheels to the brake and to hold the wagon down on to the track. The greater the amount of energy applied to the brake, the more pronounced does this effect become, and it is said that the lightest wagons may be run into the brake at the highest speed without fear of derailment.

The brake need not always conform with the arrangement shown in Fig. 1. It is not necessary, for instance, to have a brake acting along both rails. Single-rail brakes are sometimes advantageous and the eddy current brake is particularly applicable to a single rail, as no resultant torque is set up on the wagon axles, as is the case with single-rail friction brakes. The electro-magnets are wound for a D.C. pressure of 440 volts, the maximum load current being about 160 ampères. If a 440-volt D.C. supply be available, the brake can be fed direct from the mains through series resistances for control purposes, while if the supply is A.C. the brake can be fed by a motor generator set or through rectifiers, and as the magnets are only energised for very short periods, full advantage can be taken of the overload capacity of the converting plant. Two or more definite values of excitation are provided for, and even the lightest wagons can be subjected to the maximum retaining effort without danger. Provision is made for breaking the highly inductive circuit as rapidly as possible.

For controlling purposes a very simple arrangement is provided, there being two buttons for starting and stopping the motor generator set, and a control handle for the brake. Adequate protection is provided to ensure against faults at the brake and other apparatus, and mistakes on the part of the operator. In the case of an overload occurring at the brake, a lamp lights up and a bell rings outside the control cabin.

The retarder control handles, the point-thumb switches, the hump signal control, and indication lamps are mounted on a sloping panel of the control desk, which is arranged so that the operator may sit before it with an unobstructed view of the territory over which he has control. The panel may be provided with a schematic track diagram of the yard, and in this case the point-thumb switches would be situated at appropriate parts of the diagram, and there would be three indication lamps for each set of points.

At the summit of the hump there is a humping signal of the three-aspect colour light type, controlled on the "series indication" system, which repeats the actual signal on the control panel and also provides for the dual control of the signal by the operator and the head shunter.

The retarder is claimed to possess a number of important advantages over those depending purely on mechanical friction. The danger of derailment of wagons through the squeezing of the brake beams is a matter which has engaged the attention of many brake designers, and has often been a source of trouble to users, but with the eddy current brake, no trouble occurs. This, we are told, has been amply proved by tests carried out on the brake when light empty wagons were run into the fully excited brake at the highest speed obtainable, and in spite of the very rapid retardation no trace of lifting was observed. Tests are also said to show that the braking effort obtained is just as powerful as that of friction retarders, whilst on account of the very smooth entry of wagons into the retarder there is no danger of damage being done to the landing. As the braking force due to friction is small in comparison with the total force, the performance of the brake is very constant, and weather conditions, the presence of grease, roughness of the wheel surfaces, and other factors which interfere with friction braking have little effect. The freedom from moving parts, the makers point out, is an important advantage, especially where severe weather conditions are experienced. The saving in inspection and maintenance is very appreciable, for whereas the moving parts of mechanical brakes wear, and require replacement, the life of the corresponding heavy parts of the electric brake is only determined by rusting and corrosion. The vertical raising of the brake beams, which is necessary to allow locomotives to run through the retarder unhindered, is a feature of many forms of brakes, but in the present case this movement has been limited to the actual brake bars, the remainder of the equipment resting firmly on the foundation, thus promoting rigidity and ruggedness of construction.

The possibility of certain goods such as watches and clocks being injured as the result of the strong magnetic field may appear to be a disadvantage, but it seems that this possibility was realised by the German State Railway Authorities, who carried out tests on the brake installed in the Magdeburg yard, where it was found that at a height of 3ft. above the rail level the magnetic field did not damage the most delicate articles. The curves shown in Fig. 2 are typical speed-time curves taken on wagons brought to rest by this form of brake, the curve for full excitation naturally being steeper than that for half excitation.

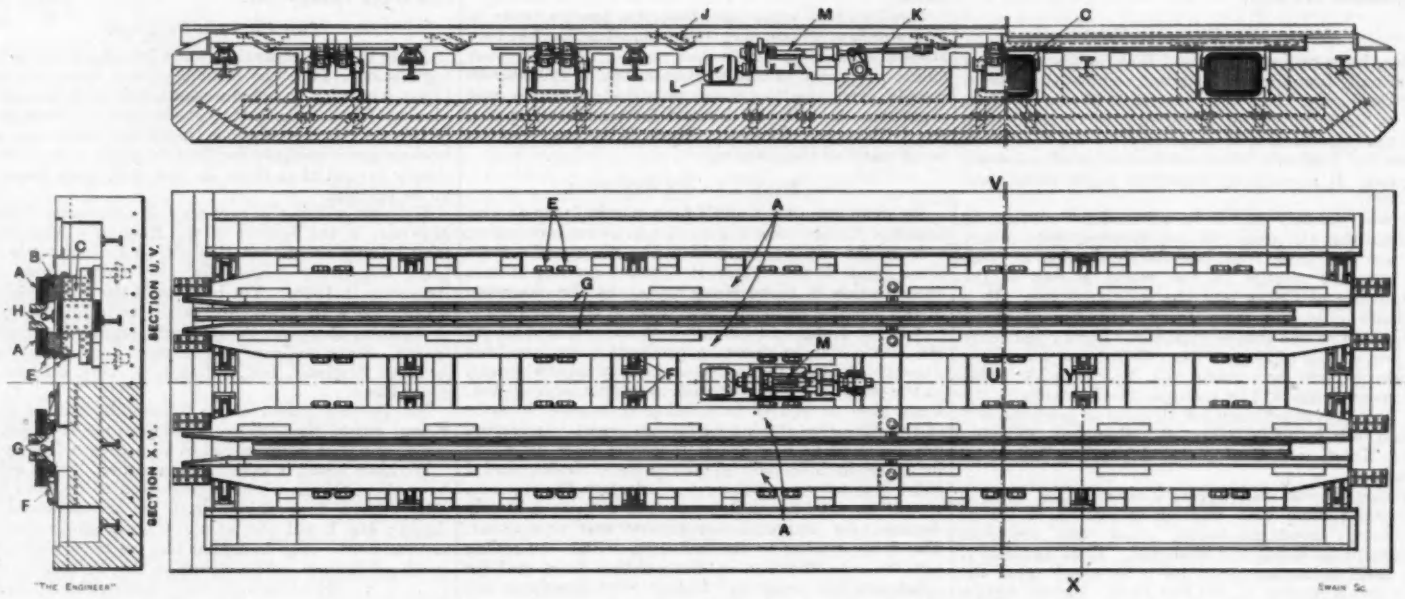


FIG. 1—PLAN AND SECTIONS OF DOUBLE RAIL EDDY CURRENT BRAKE

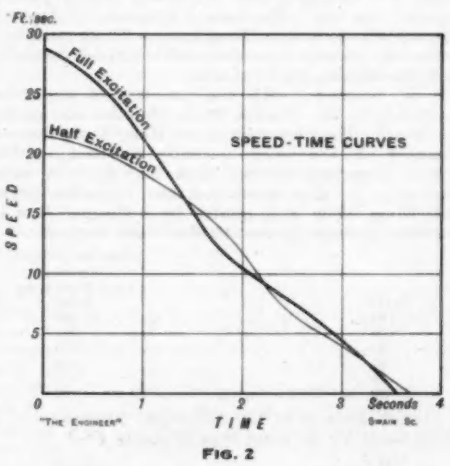


FIG. 2

SUCCESSFUL trial flights were recently made from the Rochester seaplane base, Kent, with the Short "Scipio," the first of three new metal flying-boats, each weighing 14 tons, and driven by four "Bristol" Jupiter Series X.F.BM. geared and supercharged engines, developing a total of 2400 horse-power, which have been ordered by Imperial Airways, Ltd. When they pass into service these new flying-boats, which will be the largest British marine-type passenger aircraft yet constructed, will be placed on the Mediterranean sections of the Imperial Airways routes to India and Africa. They will be capable of attaining a top speed of 130 miles an hour and of cruising at 100 miles an hour, and will carry a paying load of 7500 lb. When these three new flying-boats and the new 38-passenger Handley Page machines, which are also fitted with four "Bristol" Jupiter engines, are in commission, Imperial Airways will have a fleet of 34 aircraft, developing a total of 48,117 horse-power.

Railway and Road Matters.

AFTER being vacant since the sudden death on May 17th last of Mr. R. H. Selbie, the position of general manager to the Metropolitan Railway has been filled by Mr. J. S. Anderson being appointed to combine the duties of that office along with his present position of chief legal adviser and solicitor.

THE Postmaster-General stated on March 4th that 1924 rural stations had telephones, of which 1124 were public call instruments; the remainder were rented by the railway company concerned, which, as a rule, provided facilities for their use by the public. No information was available as to the number in urban stations.

THE Paris–Orleans express, which left the Gare Quai d'Orsay for Bordeaux at 7.23 p.m. on Thursday, March 19th, met with disaster at Etampes Station. From Press advices it would appear that the two rear coaches were derailed, and struck a train on an adjoining line. The first of the two coaches was a dining car and it was telescoped by the following vehicle. Six passengers and a train attendant were killed.

THE wages of the shopmen employed by railway companies are not subject, like those of the railwaymen, to the National Wages Board. The railways sought reductions there also, and at a meeting of the corresponding National Railway Shopmen's Council on March 18th a reduction of 10d. in the pound was accepted. The companies, on their side, agreed that short time should not reduce a man to less than five days a week.

THERE are four railway companies in the "Underground" group—the Metropolitan District, London Electric, Central London, and City and South London railways. Of the reports of these companies, perhaps the most interesting, as being the oldest, is the Metropolitan District. It shows that during 1930 the receipts were £140,646 less than in 1929, but expenditure was brought down by £122,211, but as miscellaneous receipts—net—increased by £26,913, the year ended with a gain of £4215. The number of passengers rose from 292 millions to nearly 300 millions.

THE Ministry of Transport Railway Statistics for December have recently been issued as a Stationery Office publication, price 2s. 6d. They show that, compared with the corresponding month of 1929, the number of passenger journeys decreased by 1·9 per cent. and the receipts from passengers by 4·3 per cent. The passenger train mileage, on the other hand, advanced by 1·0 per cent. The tonnage of freight traffic fell by 6·6 per cent., of which 8·14 per cent. came from merchandise and 3·62 per cent. from coal, coke and patent fuel. Thanks, though, to an increase of 7·41 per cent. in the receipts under the latter heading, there was a decrease in freight traffic receipts of only 1·44 per cent. Moreover, freight train mileage was brought down by 2·7 per cent.

BRITISH railway companies employ 37,000 engine-drivers and 27,000 signalmen, and their engines run more than 400 million miles a year, over 20,000 miles of railway. How rarely any one of this large army of men commits an act of serious negligence is shown by the fact that since and including the Ais Gill collision of September 2nd, 1913, there had been, until the Carlisle case last week, only eight instances of men having to stand their trial on a charge of manslaughter arising out of an accident. Moreover, in six of the eight cases the men were acquitted. Four of the men charged were drivers and in four instances they were signalmen—in the Quintinshill trial there were two signalmen. Coroner's law does not apply to Scotland, and it is the police authorities who take action there. Four of the trials were in Scotland and all of them resulted in acquittals.

THE London and North-Eastern Railway reports that in connection with the improvements to the Cemetery North Sidings, Hartlepool, a water softening plant is to be constructed. In addition to the water tower and softening plant, a chemical house and sludge tank are to be provided where the softening chemicals will be mixed and the residue produced by the softening process collected. The water tower will be 62ft. in height and the top will stand about 100ft. above sea level. As the seashore is only 100 yards away the tower will have the appearance of a lighthouse and will form a new landmark for shipping off the Hartlepools. The softening apparatus is to be constructed to form a cylindrical supporting column to the water tower proper and the construction will be carried out in concrete reinforced in the Hennebique method; 300 cubic yards of concrete will be used in the walls and foundations of the tower, and in view of the sandy nature of the ground it will be necessary to drive sixteen ferro-concrete piles about 40ft. long, each to carry a load of approximately 35 tons. The chemical house is to be a small one-storey building, 14ft. square, so designed that it will not detract from the appearance of the tower.

SOME very interesting information as to locomotive economics on the London and North-Eastern Railway were given by Mr. Whitelaw, the chairman, at the company's annual meeting on March 6th. He said: "We have made a marked advance in the equipment of our locomotive works with the most up-to-date machinery. The first cost is high, but we are earning a very good return by the annual savings which we make. There is no department of our undertaking in which it is more important to have the utmost efficiency than in the building and repairing works for locomotives, carriages and wagons. The great reduction which we have been able recently to make in the period required for the repair of our engines has enabled us to reduce the number of our locomotives by sixty-two during the year and 108 during the last two years. Another problem, and one still under the consideration of the officers, has been the provision of suitable water supplies. The life of a locomotive boiler in Scotland is about twice as long as the life of a boiler in England on account of the good water supply, and there seems good reason to believe that we can secure important savings by the adequate provision of water softening plants. The fullest efficiency of our engines cannot be secured as long as we have to use supplies of unsatisfactory water."

Notes and Memoranda.

A PLANT for utilising the radiant heat of the sun for developing power is being constructed in Samarkand, Turkestan. It is estimated that its output will be 210 horse-power.

SOME fine new laboratories for research and experimental work have been opened at the factory of the Chloride Electrical Storage Company, Ltd., Clifton Junction, near Manchester. They cover an area of 75ft. by 25ft. and are about 30ft. high.

ACCORDING to Mr. J. K. Dickie, if all the coal used for making coke were carbonised in modern plants designed for the recovery of gas, it would yield sufficient gas to meet about 71 per cent. of the total requirements of England, Scotland, and Wales.

THE exceeding complexity of the water areas in great portions of Canada may be gauged from a map of the Lac la Ronge district of Saskatchewan. This map sheet, which covers an area of 5400 square miles, shows more than 5000 separate lakes and 5500 islands.

IT is estimated that at present there are 11,000 Germans, 6000 Americans, and 250 Englishmen engaged in Russia as engineers and skilled workmen. In order to provide the country with native men, who might replace the foreigners, the Soviet Government proposes to expend £53,000,000 during 1931.

THE interior focussing telescope is now utilised by the Geodetic Survey of Canada, Department of the Interior, exclusively on precise and control levelling operations. The new type was first introduced on Canadian surveys in the year 1913, and results obtained ultimately led to its adoption for all high order levelling.

THE Forestry Commission of Great Britain is using Canadian Sitka spruce seed to a considerable extent in the planting of new forests. The total quantity of seed of this species sent to Great Britain up to date by the Forest Service, Department of the Interior, is over 11,000 lb. (5½ tons). This seed has all been extracted at the seed-extraction plant of the Forest Service at New Westminster, B.C.

THE possibilities of obtaining radium from the pitchblende discovered on the east shore of Great Bear Lake, in the North-West Territories, are being studied in Toronto and Ottawa. The Department of Mines at Ottawa has been urged to proceed with the tests with all possible speed, so that, if they prove as promising as are expected, exploration work may be rushed this summer to ascertain the extent of the deposits.

RECENT research work by the Imperial Institute on the resistance to sea water of ropes made from sisal and manila, carried out on Southend pier by sinking a crate below high-water mark and exposing the ropes for periods of three, six and twelve months, has produced valuable data, incidentally proving that sisal has no less resistance to the action of sea water than the lower and middle grades of Manila. When this fact is more widely known there can be little doubt that ropemakers will draw a larger supply of their raw material from British sources.

A RATHER unusual type of boiler explosion, at a Cheshire chemical works, is the subject of a recent official report. One of the bottom row of tubes in a water-tube boiler exploded, but, fortunately, no one was hurt. It was plain that the tube had not been overheated and its internal condition was good. It had, however, failed through local thinning from No. 9 S.W.G. down to No. 24 S.W.G. The thinning was very gradual and difficult to detect, although it was on the bottom side of the tube. Other tubes were found to be in much the same condition. The wastage is attributed to erosion by ash particles carried by the furnace gases. The coal used contained over 10 per cent. of ash and the draught was about 5 mm. W.G. The tube was sixteen years old.

IN an article in *Natural Resources, Canada*, which is published by the Department of the Interior, it is stated that the climate and physical character of Northern Canada are favourable for flying. There are few mountains, the climate, though cold in winter, is dry, and visibility is good. Flying is held up at times by blizzard conditions, but the saving of time is so great that the loss of a day or two is negligible and good weather may be waited for. The great river systems and the myriads of lakes which cover the whole area provide ready-made landing grounds, both in summer and in winter. With modern air-cooled engines and all-purpose aircraft fitted for operations on skis, floats or wheels, the services are remarkably efficient, and it is a tribute to the skill and care of the pilots engaged in the northern development work that no passenger has yet lost his life on any of their services and that thousands of tons of supplies have been delivered safely without loss all through the North. Many mining towns are now served with air mail services run under contract with the Post Office Department.

COMMENTING on the American idea of running two lifts in one shaft, the *Engineering Gazette* of Marryat and Place takes the case of a 24-storey building, and says:—"We have no details with regard to the speeds at which the actual machines run, but it occurs to us that if the maximum running speeds are the same, better service would be obtained by making the lower lift serve higher than half the travel. Let us try to illustrate this point. Suppose that the lifts run at the same speed, and that running as express machines they take one second per floor, while running as local machines, they take two seconds per floor. The upper lift will occupy 60 seconds for a circular trip, assuming that it stops at all floors above the tenth, while the lower lift, stopping at all floors below the tenth, will take only 40 seconds, thus necessitating an additional pause of 20 seconds by the lower lift at the bottom floor. If, however, the lower lift serves thirteen floors, it will take 52 seconds for a circular trip, and the express machine serving the upper seven floors will take 54 seconds for a circular trip. Thus, if the express lift starts from the ground floor one second before the local lift, it will arrive back just one second after the local machine has arrived, thus affording a convenient safety margin, and giving every floor approximately equal lift service."

Miscellanea.

FIVE new steel furnaces are being started up at Hamilton, Ontario, by the General Smelting Company.

THE new wireless station at Sottens, in the Swiss Canton of Vaud, was opened on March 25th, and will transmit on a wave-length of 403 m.

AN attempt is to be made this winter by a Russian pilot to establish an aeroplane service into the Arctic Circle as far as the mouth of the Yenisei River. A service has already been opened between Khabarovsk and Alexandrovsk (Sakhalin) and Kamchatka.

AS a result of various borings, three definite seams of coal have been found in the Algarrobo district, near Santiago, Chile, the lowest seam having a thickness of from 1·10 m. to 3·25 m. The nearness of the capital and the convenience of railway and other transport to the coast add to the importance of the discovery.

A TUNNEL 7ft. 6in. in diameter and 3200ft. long is to be bored under the entrance to Vancouver Harbour for the conveyance of water from Capilano Creek. It will be 400ft. below water level and will cost about 2,000,000 dollars. At present, water is conveyed across the Narrows by submerged pipes, which are considered hazardous.

THE ever-growing part taken by central electric stations in assisting industry in Canada is shown by the fact that they supplied 60 per cent. of the total power used in manufacturing in 1928. The Water Power and Hydrometric Bureau, Department of the Interior, states that of the total output produced by these central stations, nearly 99 per cent. is generated by water power.

THE third span of the Bally Bridge on the East Indian Railway was successfully floated into place on February 23rd, after only seven weeks had been occupied in its construction. The span weighs 1700 tons and was floated into place by means of two pontoons, each of 1000 tons capacity, and to ensure that the operation would be carried out successfully, the channels into which the pontoons had been taken at low tide were deepened by dredgers.

IT is reported by the National Federation of Iron and Steel Manufacturers that the number of blast-furnaces in operation at the end of February was 81, a net decrease of two since the beginning of the month, four furnaces having ceased operations and two having commenced. The production of pig iron amounted to 320,200 tons, compared with 337,200 tons in January and 607,000 tons in February, 1930. The production includes 82,400 tons of hematite, 124,900 tons of basic, 86,900 tons of foundry, and 13,700 tons of forge pig iron. The February output of steel ingots and castings amounted to 486,400 tons, compared with 402,200 tons in January, when production was affected by New Year holidays in some districts, and 776,400 tons in February, 1930.

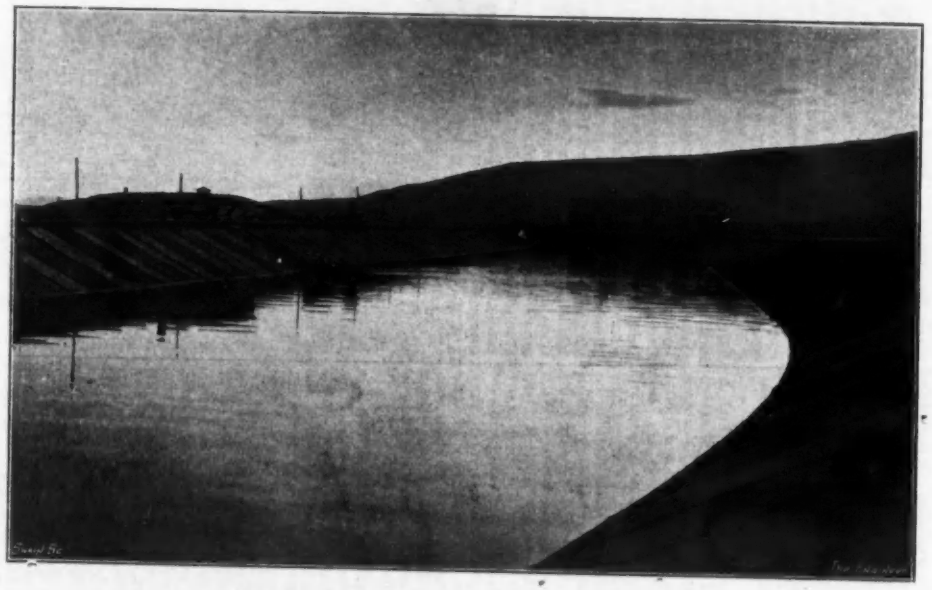
CONSTRUCTION work on the gravity section concrete dam being built across the Osage River near Bagnell, Mo., has, says the *Engineering News-Record*, reached a stage permitting the closing of the gates to start impounding water in the reservoir. The reservoir, when full, will be 130 miles long, and will have a surface area of 95 square miles, and allowing a draw-down of 30ft., will provide a storage capacity of 1,200,000 acre-feet. The dam is 2543ft. long, and reaches a maximum height of 148ft. above foundations. Initial installation of power units includes six 33,500 H.P. turbines operating under a 90ft. head. Provision is made for two additional units. A feature of the power-house design is the elimination of superstructure above the generating room floor.

AT a recent meeting of the Executive Council of the Timber Trade Federation of the United Kingdom—which is representative of all branches of the timber trade—consideration was given to the question of the attacks on the timber trade in connection with Russian timber. The following resolution was unanimously adopted:—"That this meeting of the Executive Council of the Timber Trade Federation of the U.K. affirms as its considered opinion that the purchase and dealing in all woods, the import of which is permitted, is inevitable; the Council, therefore, takes the view that the action of certain public bodies and companies in refusing to accept Russian wood on account of its origin, tends to market instability injurious alike to traders and users of timber; that, in view of the offer of the Russian Government to give facilities for the independent examination of the conditions in the timber camps, the Council protests against any discrimination against Russian wood; that this Council is also of opinion that there should be an independent investigation into the conditions in the timber camps."

A NEW high-speed air-rail service is to be inaugurated on April 1st operating between 140 railway stations in this country, and any of the airway stations of Imperial Airways in Europe, Egypt, Iraq, India and Central Africa. By an arrangement, just completed between Imperial Airways and the Great Western, London and North-Eastern, London, Midland and Scottish, Metropolitan, and Southern railway companies, air-rail savings of time of more than a month between England and India, and England and South Africa, will become possible as compared with ordinary surface transport. Urgent freight, handed in at railway stations for rail-and-air despatch, will be marked with a special label and forwarded to London by the next express train. On arrival it will be collected from the railway terminus by one of the Imperial Airways motor vans and taken to the London air-station, where it will be placed at once on the next air-liner ascending for the destination indicated. As an instance of the cost of the new system, the charge for a 14 lb. parcel by air-rail, from Leeds to Cologne, will be 9s. 6d., and from Birmingham to Prague 13s. 10d., while, as an indication of time-saving, it may be mentioned that freight consigned by train and air from Plymouth to Marseilles will accomplish its journeys in two days, as compared with four days by surface transport. In the reverse direction, parcels will be accepted at any of the stations of Imperial Airways for despatch by air to London, continuing on from London to destinations on any of the railways already mentioned by the next express train.

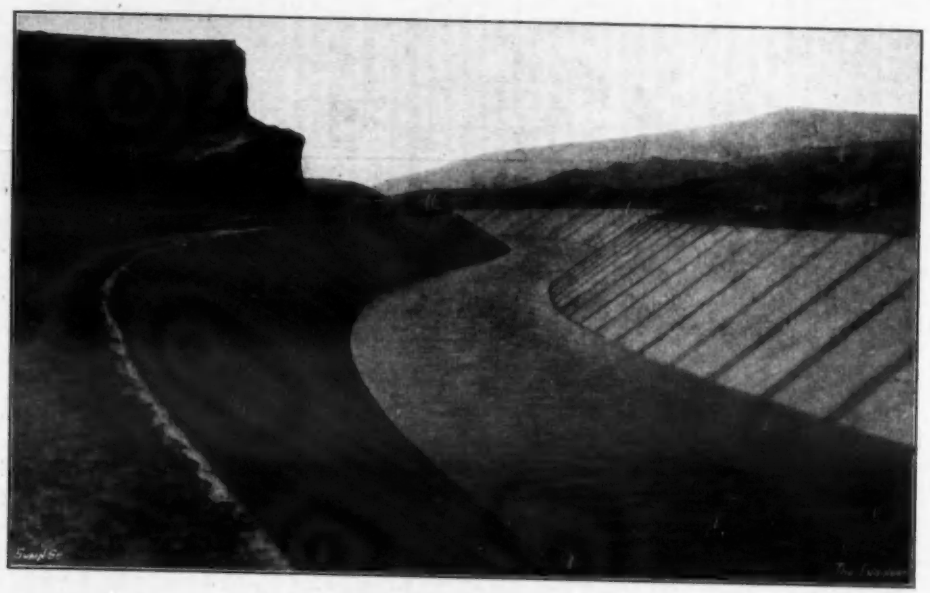
HYDRO-ELECTRIC POWER WORKS IN PALESTINE

(For description see page 352.)

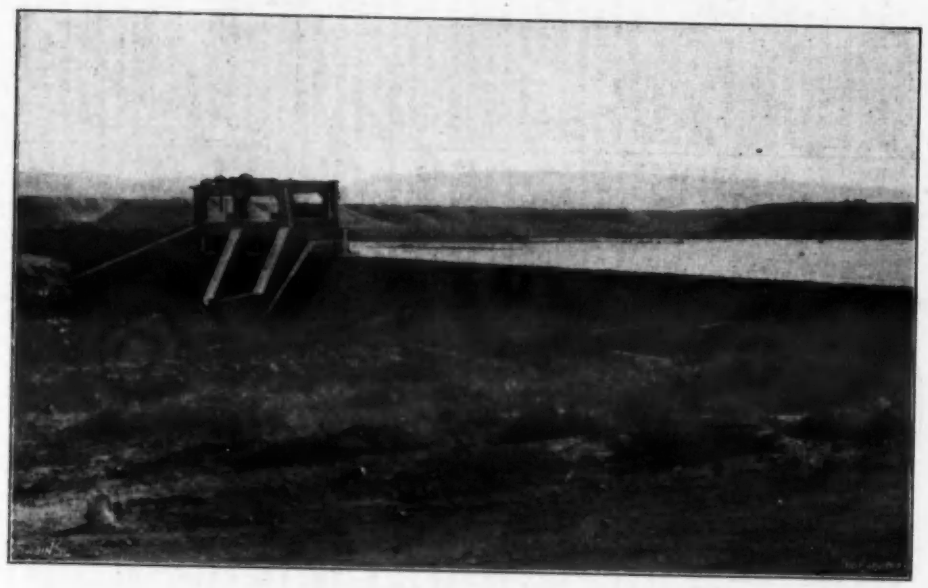


THE HEAD-RACE CANAL AT JISR-EL-MUJAMEH

THE RIVER YARMUK BELOW THE YARMUK DAM



THE JORDAN CANAL



THE YARMUK DAM

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The Metallurgist.

THE MARCH NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE ENGINEER.

VOL. CLI No. 3924

MARCH 27, 1931.

British Prices in Foreign Markets.

THE policy of socialism has never entirely escaped from the "desert island hypothesis." We cannot recall who was the first economist to make use of that ingenious fiction. All that is required is an island, isolated from the world, blessed almost with as much plenitude as the Swiss Family Robinson could have desired, and peopled by inhabitants possessed, without exception, of the qualities which distinguished that Early Victorian kindred. Given these premises, it is possible to construct a social organisation as perfect as a machine; a mechanism in which all the cogs and levers act in such complete harmony that disturbance of its activities is inconceivable and the whole advances constantly in wisdom, prosperity, piety and contentment. Here we have a community which has turned the curse of the Garden of Paradise into a blessing, labour has become a pleasant recreation, and the covetousness of mankind—which breeds enmity—has been obliterated by the facility with which all the necessities of existence are satisfied. In such an island all the schemes of the socialist are practicable. But, alas! it is an island of dreams and nothing more. A thousand and one things step in to mar its perfection, and we have to acknowledge that in a common workaday world the aspirations of those who seek for Arcadia are never realised. Most of all is it true that this little island of ours is as remote as can be from the hypothetical unit of the paper economists. It cannot live by itself, for itself. It is part and parcel with the nations of a vast Empire, and a mere item in the industrial cosmos.

Although never a day passes without evidence of that fact being thrust before every one of us, there are yet many who seem desirous to ignore it, or, if shown that they are out of step with the world, tell the world to change its. For the last few years this country has been augmenting its social burdens as if it were indeed the hypothetical island, and with disastrous disregard of the fact that in a vain effort to make a land fit for heroes to live in it will leave us no land at all. It must not be forgotten that nothing which we do here is without its repercussion upon our foreign trade. If we raise wages or shorten hours, give a dole, increase the years of free education, enlarge the field of insurance, or add to the number of free clinics, nay, even if we do no more than put electric lights over the bedheads of paupers and provide them with gratis copies of revolutionary literature, we add something to the difficulty of carrying on foreign trade against competitors who do not make such generous gestures to an ever-increasing electorate. None of these things can be done without increasing the price of commodities, and it is price that is hampering our success in foreign markets. Technological progress has brought many comforts to the world, industrial reorganisation has done much to diminish the cost of amenities; but such things are no longer our prerogative; they belong to all nations. Let us pursue them to the uttermost and we shall only remain on a par with other nations. From them we can gain nothing; only lose by not employing them. Did all nations possess them, differences would then not reside in the actual costs of manufacture, but in the burden placed upon industry by expenditure upon non-productive services or by the payment for labour at higher rates per piece produced. A succession of notable monographs have insisted upon this truth. They have shown that the burden of taxation, rates and wages is rendering it impossible for Great Britain to compete with less altruistic or less extravagant nations. Commissioners to foreign lands have all come back with the same tale—that price is ruining the British market. Sir Arthur Balfour, chairman of the United Kingdom Trade Mission, has recently returned from Egypt with the same conviction. Lord Wester Wemyss referred to it in his Presidential address to the Institution of Naval Architects on Wednesday last, and the F.B.I., in a pamphlet entitled "Industry and the Nation," lays stress upon it. "British production costs," says the latter, "must be at such a level as will enable the selling price to attract overseas buyers and at the same time provide those who invest their capital and devote their energies to the initiation, development and management of British industry with a net return comparable with that received for similar services in other countries." The second part of that quotation will escape the eye neither of the astute reader nor of the socialists who profess to believe that the possession of capital is a crime and that inducements to work are unnecessary. Taxation not only drives up the price of commodities, but discourages the investor and the manager. To quote again from the F.B.I. pamphlet: "The psychological effect of crushing taxation, while difficult to measure, is none the less serious. Progress in industry derives its impetus to some extent at least from a spirit of adventure. Such a spirit does not flourish while enterprise is expected to pay the penalties of failure without being allowed to reap the rewards of success." The employer is not in the happy position of the workman, who may increase his earnings by piecework or bonus, but cannot lose his standard rate by lack of diligence. If the employer succeeds a great portion of his earnings are taken by taxation; if he fails he loses all. He has to pay the penalties, but is not allowed to reap the full rewards. That does not encourage either the manager or the investor, and it is scarcely surprising that the latter hesitates to put his money into industry, whilst it *is* surprising that, despite such discouragement, the manufacturer still struggles to keep his plant up to date and shows enterprise in the pursuit of new developments.

One may often hear it said that British prices are high because British methods of manufacture are antiquated or because British industrial methods are bad. These statements are not completely true, but even if they were, the fact would still remain that with the most perfect methods and organisation in the world, that is to say, the equal of the best of our competitors, Great Britain would still have to face a higher burden of taxation than any of the others and higher wages than most. Hence the margin for profits would be lower and the encouragement to industry and the investor be less. From that issue there is no escape. Whatever course we take, whatever remedy we attempt to apply, we shall in the long run be driven to the same conclusion that we cannot make lavish outlay upon non-productive services, we cannot pay high

wages in sheltered industries, we cannot maintain the unemployed in comfort, and yet hope to meet in open competition industrial nations which refuse to do any of these things.

Railway Accident Reports.

THE coroner's inquest, arising out of the Carlisle derailment of January 3rd, had a painful ending. The jury, after an absence from court of only nineteen minutes, returned a verdict of manslaughter against Eskdale, the driver of the express. After the inquiry before Colonel Mount on January 13th and 14th one might have been prepared for such a conclusion, but Eskdale on that occasion was so emphatic in his statement that he had obeyed the respective speed limits of 10 and 15 miles per hour approaching Carlisle, that, despite the evidence to the contrary, one hoped that, somewhere or other, another cause would be found. Such, however, was not to be the case. At the coroner's inquest last week there was no variation in the evidence as to the speed, and nothing new was brought out as to the condition of the track, the engine, or the rolling stock, and Eskdale did not in the least modify the tale which he told to Colonel Mount. He maintained that he passed through Canal Junction at the prescribed speed of 10 miles per hour, released his brake in order that the train might run forward, and that he was running at 15 miles when he entered on the second curve. Then, suddenly, without any warning, the train, he said, stopped dead, the engine fell from under him, and turned on its side. As all the facts recorded at the coroner's inquest were the same as those brought out at the Ministry of Transport inquiry, exactly nine weeks previously, the question may be asked why the inquest was not proceeded with earlier. We submit that the answer is that the coroner was waiting for the publication of Colonel Mount's report, but when it became clear that that would not be available for some time the coroner decided to go on; in any case, all the proceedings at the Ministry of Transport inquiry had to be gone over again, as none of the evidence then given was formally before the jury. The reason why Colonel Mount's report has not been issued is a very interesting one, as it involves a consideration of the whole purpose of a railway accident inquiry, and it is worth while devoting a few moments to it.

Whilst the investigation of the circumstances that lead to railway mishaps was not sanctioned until 1871, such inquiries had been held since 1840, ostensibly under the Regulation of Railways Act of that year, which gave the Board of Trade powers over new railways, ordered accidents that had been attended with personal injury to be reported, and sanctioned the appointment of inspecting officers of railways. It is obvious, therefore, that the object of the inquiry was less to determine the cause of an accident than to find what action was necessary to avoid similar mishaps. That was made clearer in the Act of 1871, by which inquiries were legally established, as the inspecting officers were then called upon to "make a report to the Board of Trade stating the causes of the accident and all the circumstances attending the same, and any observation thereon or on the evidence or on any matters arising out of the investigation which they think right to make." In effect, the reports were more concerned with pointing out the weak spots in railway administration than the faults of individuals and, distasteful though it was at the time, it is now generally recognised that the remarkable safety that has attended the operation of British railways during the last forty or fifty years has been due to the persistence of the inspecting officers of railways in their recommendations for improved signalling, the adoption of the block system, and the provision of continuous brakes for passenger trains, all of which culminated in the Act of 1889, which made those safeguards compulsory on passenger-carrying railways. Such reports, like those of to-day, often criticised the conduct of the individual or individuals concerned, but it would have spoiled the whole purpose of the inquiry had such criticisms been used against the men, particularly if criminal proceedings for negligence had been commenced or were at all likely. It has, therefore, always been the rule in fatal accidents where men have been seriously at fault, to hold back the inspector's report until any proceedings have been closed, or are not likely to be undertaken. As an illustration, we may quote a well-known case. The Ais Gill collision occurred on September 2nd, 1913, and was inquired into by Sir John Pringle. Under the coroner's warrant, driver Caudle was indicted for manslaughter, and was tried and sentenced at Carlisle Assizes the following month. The case aroused considerable sympathy, and the man, instead of serving some months' imprisonment, was released in a fortnight—and, incidentally, went back to his work. Sir John Pringle's report was dated October 10th, but as it did not appear until November 25th, it was evidently kept back so as not to influence Caudle's position.

It may be useful if we take advantage of this opportunity to add some further remarks on this question of railway accident reports. Their number, for instance, is an indication of the extent to which accidents occur. All mishaps, including failures of equipment, like couplings, are reported and duly reviewed by the Chief Inspecting Officer. Inquiries are always held into fatal accidents, but also even into the most minor collision or derailment that suggests a weakness in administration or equipment. Despite such a possible wide field to be covered, it is considered necessary to inquire into less than twenty accidents a year. Another point we would make is that the accident inquiries of to-day are of a different character from those of fifty and sixty years ago. With the great perfection of equipment and operation that has been reached, causes are less simple and so call for prolonged investigation, and, occasionally, for tests—particularly is that so in some derailments. In all this, however, the inspecting officers find the willing co-operation of the railway companies' representatives, and it is safe to conclude these observations with the remark that that co-operation has greatly assisted in giving British railways their splendid, well-earned reputation for safety in travel.

The Central Electricity Board's Report.

THE third annual report of the Central Electricity Board, covering the year January 1st to December 31st, 1930, has just been issued. At the date of the Board's previous report, schemes for five areas had been adopted by the Board, namely, Central Scotland, South-East England, Central England, North-West England and North Wales, and Mid-East England. During 1930 schemes for three other areas were adopted by the Board, namely, North-East England, South-West England and South Wales, and East England. At the end of the year a scheme for South Scotland—received from the Electricity Commissioners on December 8th, 1930—was still under consideration.

The eight schemes adopted cover 71·8 per cent. of the total area of Great Britain, 97·6 per cent. of the total population, and 99·4 per cent. of the output of electricity by authorised undertakers. The addition of the South Scotland scheme, if adopted, will bring the area covered by the schemes up to 76·7 per cent., the population to 98·2 per cent., and the outout of electricity to 99·5 per cent. There is only one area remaining, namely, North Scotland, which, while it represents 23·3 per cent. of the area of Great Britain, accounts for only 1·8 per cent. of the population and 0·5 per cent. of the output of electricity. Arrangements which the Board has made with the owners of the Grampian water power undertaking in the North of Scotland have in some measure anticipated the work of co-ordination and interconnection which may be finally decided upon in that area. To all intents and purposes therefore the initial survey of the country is now complete, and the Board's activities have been set in motion in almost every area.

During 1930 great progress was made in obtaining the necessary wayleaves for the erection of transmission lines, approximately 1000 miles of wayleaves having been secured in the course of the year. The acquisition of sites for the transforming stations also progressed rapidly, and the quicker machinery provided by the Public Works Facilities Act, 1930, for obtaining land compulsorily has proved decidedly helpful to the Board.

By the end of 1929 the Board had approved contracts for works in connection with the "Grid" in the five areas for which schemes had been adopted up to that time at a total cost of £10,899,692. During 1930 the Board placed further "Grid" contracts for those schemes and contracts for works in connection with the three schemes which were adopted during the year at a total cost of £7,368,137, making the total value of contracts entered into in connection with the construction of the "Grid" by December 31st, 1930, £18,267,829. The South-East England scheme accounted for the greatest value of contracts placed, namely, £7,054,649. Next in importance to it come the North-West England and North Wales scheme, with £2,694,676; Central England, with £2,252,973; Mid-East England, with £2,247,756; and Central Scotland, with £1,727,447.

During the year the construction of transmission lines made steady progress in the five areas for which schemes had been adopted by the end of 1929. The necessary towers have been erected and cables laid along approximately 950 miles, an increase during the year of over 600 miles. By the end of the year the Board had, in addition, approximately 500 miles of its overhead lines and cables in actual operation, and other sections were practically ready for operation.

The adjustment of programmes for the standardisation of frequency has now been practically completed for the areas in which standardisation is a necessary part of the area scheme. Having regard to the fact that the cost of standardisation has ultimately to be borne by means of a levy on the supply industry as a whole, the Board regards itself as trustee for the industry, and its practice has been not only to obtain agreement with the undertakers affected in respect of the programme for standardisation to be carried out by those undertakers, but also to arrange for the work to be done by them in collaboration with the Board's engineers. Before any work is actually begun as part of the frequency change, steps are taken to ensure that the work is a necessary part of the change, and that the method proposed is the most economical way of carrying it out. All through the change-over process the Board's accountancy staff conduct a continuous audit, so that no question may subsequently arise as to the purpose to which the undertakers have applied the money. As the result of arrangements made by the Board during 1930, a total sum estimated at £9,969,550, spread over the next few years, will be spent on the standardisation of frequency by the supply undertakers affected, and this, added to the expenditure of £8,569,900 arranged in 1928 and 1929, gives a total expenditure of £18,539,450, made up as shown in the following table:

	£
Central Scotland	3,781,200
Central England	4,336,700
North-West England and North Wales	452,000
North-East England	9,065,100
South-West England and South Wales	804,450
South-East England—	
Deptford generating station and undertaking of London Electric Supply Corporation, Ltd.	100,000
	£18,539,450

The estimated cost of work for effecting standardisation specifically approved was at the beginning of the year £788,011. Approval was given during the year for further expenditure amounting to £3,473,029, making the total value of the standardisation work in progress, or completed at December 31st, 1930, £4,261,040, the amount actually paid at that date being £1,821,385. The areas most affected by the standardisation of frequency are North-East England, Central England, and Central Scotland, and the installation of new or altered electrical plant on consumer's premises will contribute to the work of modernisation and re-equipment of the most important industrial establishments in the country.

Extensive sections of the 132-kV and lower-voltage systems were put into service during the year, and as the operating characteristics have proved to be in accordance with calculations, it is not proposed to make any alterations in the basic designs of the "Grid." There have been no changes in the standards initially adopted for the system of supply, voltage, and current-carrying capacity of the transmission lines. Steel-cored aluminium conductors of the normal type with circular strands were used on all lines constructed during the course of the year, but as an experimental measure a modified type of conductor having sector-shaped aluminium instead of the more usual circular strands is being tested. This construction reduces the overall diameter of the conductor, with consequent reduction of wind and ice loading. The reduction of overall diameter tends to decrease the critical corona voltage, but this effect is counteracted by the smoothness of surface of the new conductor, and it is also claimed that the conductor has some advantage over the standard type in regard to its ability to resist corrosion.

Experience with the standard types of conductor clamps, which are largely of American and continental design, has shown that there is room for improvement, and new types are being developed which appear to remove the disadvantages without increase of cost. It is anticipated that the new clamps will be available for the remaining sections of the "Grid." The standard types of lattice steel towers have been used on all lines built during the year, but the advantages in certain respects of reinforced concrete and of wood as alternatives to steel towers have not been overlooked. So far, however, there has been no justification for adopting either of these alternatives, although the situation will be reviewed from time to time, so that advantage may be taken of any technical improvements that may arise.

Experience in Scotland has led the Board's engineers to adopt the policy of adjusting the insulation of the overhead lines in accordance with the atmospheric conditions in which they operate. For lines in open country remote from industrial districts, the suspension insulator chains for 132-kV lines consist of nine standard units or their equivalent, but where the conditions are less favourable—that is to say, where there is considerable pollution—suspension chains of ten or eleven units are used. The eleven-unit chains, however, are only necessary in cases of extreme atmospheric pollution, such as occur in the neighbourhood of large industrial cities. As there is a combination of fog and atmospheric pollution which is peculiar to the British Isles, the Board has embarked upon a programme of research with a view to

determining the best methods of increasing the factor of safety of the line insulation during fog conditions. In these researches the Board is co-operating with the National Physical Laboratory, so that the test results may be entirely scientific and of general application.

An interesting development in the detail design of discriminative protective gear completed during the course of the year consists of providing means whereby potential supplies for distance relays can be taken directly from the 132-kV system, the advantages of the scheme being improvement in accuracy of discrimination, reduction of maintenance costs, and the possibility of small supplies of power being obtainable direct from the transmission lines at economic rates is materially increased. Progress in the design of transforming stations was entirely normal, and only minor details of design are under reconsideration at present. Metering equipments of the types used in both selected and non-selected stations are now in service in Central Scotland and South-East England; whilst in Central England and North-West England special meters are in use to meet the circumstances in which temporary supplies are being taken and given.

Obituary.

CHARLES WICKSTEED.

By the death of Charles Wicksteed, which took place at his home in Kettering on Thursday last week, March 19th, we lose one of the oldest members of the Institution of Mechanical Engineers, and an engineer of singular ability and wide talent. Had he lived until the end of this month he would have attained his eighty-fourth year. He was born at Leeds in 1847, and his father was a famous Unitarian minister, the Rev. Charles Wicksteed. One of his brothers was the late Rev. P. F. Wicksteed, a renowned Dante scholar, and another the late Hartley Wicksteed, for many years managing director of Joshua Buckton and Co., Ltd., of Leeds, and President of the Institution of Mechanical Engineers, 1903–4.

Charles Wicksteed went to school at Lancaster, and was apprenticed to Kitson and Co., Ltd., of Leeds, where he received a thorough training in locomotive and general engineering work. At the early age of twenty-one he began business for himself at Swaffham, in Norfolk, as an owner and operator of steam ploughing tackle. Some of the early experiences in Norfolk, Northamptonshire, and other districts, which are set down in Mr. Wicksteed's own book "Bygone Days and Now," throw an interesting light on the varied and often difficult circumstances which led later to the foundation of the engineering works in Kettering. It is recorded that often when taking in water for an engine at Barton Seagreave, he expr ssed the wish that one day he might own that land. He went to Kettering in 1872 and four years later the firm, which later became Charles Wicksteed and Co., Ltd., was founded at the Stamford-road Works. More than once the need of one industry has led to the beginning of a new industry. In the operation of ploughing tackle, Charles Wicksteed had often felt the need of spare parts and special tools and devices which would facilitate engine repairs. The absence of such tools and appliances at the time led him to invent and make his patented tube expanders and other tools, such as saws for hand and power operation, with which he began his later business in small machine tools.

In 1874 he gave up the ploughing tackle side of his work and handed them to Mr. J. P. Grundy, in order to give more time to his machine tool business. Incidentally, we may mention that in the early days of the cycle he was the maker of an excellent bicycle. During the war the Wicksteed works were mainly occupied in the making of munitions, but they also specialised in the production of limit gauges and gears, which later added new branches to the business.

The idea of creating a park for the children and people of Kettering was uppermost in the mind of Charles Wicksteed before 1914, and a few years later he presented the Barton Seagreave Hall and Estate to the community. It was first named the Barton Park at his own request, but by general consent the name was altered to that of the donor, and will always be a lasting memory of the man and his work. Whilst designing and laying out the park and its artificial lake, Charles Wicksteed considered the problem of designing safe playground equipment, and again this new development added a fresh and growing department to his business. Once during a period of depression at the works, he transferred his men to the park and was thus able to give them continued employment, an incident which showed the manner of man he was. He constructed a notable racing track in the park, and at the present time a miniature railway is under construction and will shortly be completed to his designs.

He was an engineer of the old school, who gained experience alike in difficult and successful times, and applied his knowledge to break up new fields of development. Possessed of a strong personality and determined views, he was a good speaker and could always hold an audience by the energy and raciness of his diction. Up to the last he retained extraordinary vigour, and at the summer meetings of the Institution of Mechanical Engineers he entered into all the entertainments, including dancing, with even more enthusiasm than the younger people.

CAPTAIN T. J. TRESIDDER.

It is with great regret that we have to record the death of Captain Tolmie John Tresidder, C.M.G., late R.E., who for many years was a director of John Brown and Co., Ltd., and an authority on armour and projectiles. Captain Tresidder died at his home in Upper Norwood on Friday last, March 20th, at the age of eighty-one. He was the elder son of the late Surgeon-General Tresidder, of H.M. Indian Medical Department, and was born at Chunar, India. After completing his education at Dulwich and the Royal Military Academy, Woolwich, he joined the Royal Engineers, becoming Lieutenant in 1870 and Captain in 1882. He spent over ten years in Malta, where he carried out the drainage scheme of the five fortified cities, and was twice thanked by the Commander-in-Chief for his services. He retired from the Army in 1887. His mathematical attainments and aptitude for ballistics found use in his work with John Brown and Co., Ltd., where he devoted himself chiefly to the development of armour and armour-piercing projectiles. In 1871, jointly with the late Mr. J. D. Ellis, he invented the system of chilled compound plates, combining the cementation and chilling processes in a manner which increased greatly the shot-resisting power of armour. This process was continued until 1896, when the firm's armour plants were adapted for the Krupp process.

Before he retired from active management in 1902, Captain Tresidder designed and supervised the installation of a complete new armour-making plant at the Atlas Steel Works of John Brown and Co., Ltd., Sheffield. He continued to hold the office of a director of the company, to which he was appointed in 1894, until last year. He was also a director of the Anglo-French Nickel Company, Ltd., of Swansea. In 1907 he read a paper on "Modern Armour and its Attack" before the Institution of Naval Architects, and he was awarded the Institution's Gold Medal the following year. He also received the Bessemer Gold Medal for original research.

Captain Tresidder was the author of many published works on armour and projectiles and the laws of high-speed punching. Towards the end of the war he invented a special device for de-capping shells. It took the form of protective steel mats, and was fitted to a large number of battleships and cruisers. He was also the inventor of a slide rule for calculating the striking velocity of shell against armour, which found extended use. Even during the last two years his inventive faculty was not idle, and he patented two new types of micrometers for the internal and external fine gauging of parts.

RESTAL RATSEY BEVIS.

Marine engineers will learn with regret of the death on Saturday of last week, March 21st, at Birkenhead, of Mr. Restal Ratsey Bevis, who was for many years the managing director of Cammell Laird and Co., Ltd., of Birkenhead. Mr. Bevis was born at Petropolis, Rio de Janeiro, Brazil, in 1854. His father, Mr. Ratsey Restal Bevis, was for many years one of the principals of Laird Brothers. In 1870 young Bevis was apprenticed to Laird Brothers, of Birkenhead, and in his training during the following seven years he obtained a wide knowledge of the firm's work, after which he spent a period of three years at sea in ships of the National Steamship Company and the Pacific Steam Navigation Company. In 1877 he was appointed assistant engineering manager at Birkenhead with charge of the outside work, including repairs to hulls and machinery, and with the control and management of trials. Later he became the engineering manager, with the full charge of all the plant and the management of the docks. When, in 1900, the firm became a limited liability company, Mr. Bevis was appointed managing director and general manager, a position he held until his retirement in 1912, when he was succeeded by the late Sir George J. Carter. During his management of Laird Brothers he was responsible for one of the first "River" class type destroyers built for the British Government, immediately followed by H.M.S. "Swift," the pioneer of high-powered, high-speed "leaders." Although about 1912 he practically retired from active business pursuits, he retained office in a consulting capacity until 1920. Somewhat later he became a director of the Liverpool and North Wales Steamship Company, and he was also a director of Chadburns, Ltd., and the Fairfield Shipbuilding Company, Ltd., for some years. He was a member of the Institution of Civil Engineers, a past-President of the Liverpool Engineering Society, and Member of Council of the Institution of Naval Architects, and a member of the Shipwrights' Company. He took a great interest in the Royal Naval Volunteer Reserve, and was an Hon. Lieutenant. He was greatly respected in Birkenhead and Liverpool, and a large number of engineers attended his funeral at Birkenhead on Wednesday last, March 25th.

Books of Reference.

Specification, 1931: *For Architects, Surveyors, Civil Engineers and all Interested in Building*. Edited by Frederick Chatterton, F.R.I.B.A. London: The Architectural Press. Price 10s. 6d. net.—This volume has now reached its thirty-third year of publication, and, as in earlier editions, opens with a few articles of interest. This year they are: "The Preservation of Timber," by J. Bryan, M.Eng.; "Speed in Building: Its Method and Attainment," by E. Maxwell Fry, B.Arch.; "The Architectural Uses of Glass," by O. P. Bernard, L.R.I.B.A.; "Schools," by G. H. Widdows, F.R.I.B.A.; and "Ice Skating Rinks," by S. Clough, F.R.I.B.A. The book is sectionalised as follows: Roads and Footways, Excavator, Drainlayer, Bricklayer, Pavior, Concretor, Mason, Structural Engineer, Carpenter and Joiner, Roofer, Metal Worker, Plumber and Sanitary Engineer, Plasterer, Ironmonger, Glazier, Water Supply, Heating, Ventilating, Illuminating, Gas, Electricity, Painting and Decorating, Furnishing, Proprietary Building Materials and Specialities, Building Practice and Miscellanea. A note on the title page reads: "'Specification' is as necessary to the architect as an encyclopædia is to the man of letters, and it possesses the outstanding advantage of being a single volume." From our own experience in the use of this book of reference we can endorse that statement.

The Year-book of the Scientific and Learned Societies of Great Britain and Ireland: A Record of the Work Done in Science, Literature, and Art during the Session 1929–1930. London: Charles Griffin and Co., Ltd., 42, Drury-lane, W.C. 2. Price 18s. net.—The Preface of last year's edition of this annual volume contained a statement that, owing to lack of support, publication would probably have to cease. As a result, a large number of communications were received by the publishers, suggesting that the book be issued in an abridged and less expensive form, and we are pleased to be able to record that the publication of the book will be continued, although future editions will not contain the alphabetical lists of papers read before the institutions and societies.

The Mining Year Book, 1931. By W. E. Skinner. London: W. E. Skinner, 15, Dowgate-hill, E.C. 4. Price 20s. net.—This reference book contains, in alphabetical order, full particulars of some 1420 mining companies—gold, diamond, copper, tin, silver, platinum, lead-zinc, and iron—and also of exploration, mining investment and finance companies. Owing to the large amount of foreign capital invested in British mining concerns and the international interest now taken in this industry, particulars of the principal mining companies of all countries are included, and the volume can be said to contain details of all the chief mines in existence. With the many changes that occur yearly in the general particulars of mining companies, the possession of this reliable, up-to-date reference book has become a necessity to all connected with the industry.

SIXTY YEARS AGO.

From our issue of March 31st, 1871, we extract the following information concerning the current activities of certain individuals, famous or otherwise:—Professor Osborne Reynolds—he had not yet come to the height of his fame—had recently presented before the Manchester Literary and Philosophical Society a paper entitled "On the Tails of Comets, the Solar Corona and the Aurora." He attributed the cause of these phenomena to electrical discharges under different conditions. The recently formed Iron and Steel Institute had held its annual general meeting during the week at Willis' Rooms, London. The president was Mr. Henry Bessemer. In the course of his presidential address, he touched upon the efforts being made to devise a satisfactory machine for replacing the labours of the iron puddler and upon the most recent methods of improving iron and steel, such as by the addition of iodine or the ashes of seaweed to the charge in a puddling furnace or a Bessemer converter. Monsieur Schneider, disheartened, apparently, by the situation in France, was on a visit of inspection to this country, and was commonly believed to have in mind the establishment within our shores of a new works. Commander Selfridge, chief of the American Darien Expedition, reported that he believed he had found a suitable route for a canal across the Isthmus. He proposed to make a cut of 50 miles through the watershed between the rivers Atrato and Cacurien. Captain Silas Bent, of St. Louis, had issued an alarming statement concerning the effect which would be produced by joining the Atlantic and Pacific by a channel through the Isthmus of Panama. He assured the world that such a channel would change England, Germany and Northern Europe into a waste of ice and snow. We were, however, comforted by the words of Dr. Carpenter, who told us that such a channel, if made, would really have very little effect on our climate. The idea of the alarmists was doubtlessly that the channel would carry the Gulf Stream into the Pacific. In considering this subject to-day, it should be noted that the proposal was to cut a channel without locks. Her Majesty Queen Victoria had, during the week, formally opened the Royal Albert Hall of Arts and Sciences. We acclaimed the building a magnificent success, and although we disliked the scheme of drapery adopted for the auditorium, we were enthusiastic in our praise of Mr. Willis' great organ. Even at that date, however, the famous Albert Hall echo had obtruded itself on everyone's attention. Madame Patey—*sic*—and Mr. Santley had survived the opening ceremony unaffected by the echo, but Madame Sherrington's voice was so pitched as to arouse the echo so strongly and distinctly as to make it appear that she was being followed by a weak-voiced imitator.

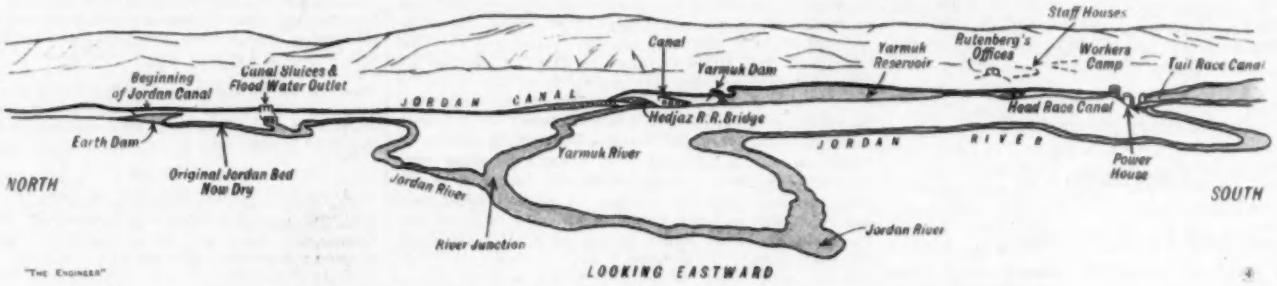
Hydro-Electric Power of the Jordan.

By HAROLD J. SHEPSTONE, F.R.G.S.

THE scheme for giving Palestine a supply of electric power has now been partially realised by the completion of the first of three hydro-electric generating stations on the river Jordan. The scheme called for the utilisation of the power resources of the Jordan from its source to the Dead Sea, including its main tributaries, the rivers Yarmuk and Jabbok.

The yearly rainfall in Palestine is approximately the same as the average for European countries, but the rains are concentrated during a short winter season, in which the rivers become formidable torrents. To utilise this water for power and irrigation purposes, it was essential that it should be stored up during the winter months and drawn upon as desired in the summer. The proposition called for careful survey of the whole Jordan valley and the Sea of Galilee, and demanded the creation of artificial lakes for storage purposes, and the construction of many miles of canals.

Rising on the slopes of Mount Hermon in the Anti-Lebanon range, the Jordan flows into Lake Huleh or the Sea of Merom, and thence into the Sea of Galilee, from which it emerges as a rushing torrent, finally emptying itself into the Dead Sea. Between its source and the Dead Sea there is a fall of over 900 m. (3000ft.), a tremendous drop considering that the total distance of the stream in a straight line is but 104 miles. But the Jordan is one of the most serpentine streams in the world. As the crow flies, the distance between the Sea of Galilee and the Dead Sea is only 66 miles, but owing to its many windings, the river traverses almost three times that distance.



PANORAMIC MAP OF THE JISR-EL-MUJAMEH POWER SCHEME ON THE JORDAN

640 horse-power was also installed for lighting the camp and driving the machinery.

Two dams have been built, one across the Jordan and the other across the Yarmuk. The latter is about 30ft. high, and has resulted in the formation of a lake with a water area of 1,200,000 square metres. This acts as an intermediary reservoir for feeding the Sea of Galilee and ensuring the requisite flow for driving the turbines in the power-house. The dam is provided with automatic floodgates with a capacity of 1000 cubic metres per second.

The second dam, which crosses the Jordan at the village of Delhamieh, is slightly smaller than the first. It has resulted in the formation of another lake, but what is more essential, it has raised the waters of the Jordan to the necessary level, and permits them to be diverted by a concrete lined canal, 6000ft. in length, into the Yarmuk reservoir. The canal passes under the Haifa–Damascus Railway, as well as under the Semakh–Beisan road, necessitating the erection of special bridges at these points.

A second concrete-lined canal, 1600ft. long, with a capacity of 160 cubic feet per second, carries the waters of the Yarmuk reservoir to the penstocks of the power-house at Jisr-el-Mujameh. This is the station that has just been completed. It has an output of 16,000 horse-power, generated by two turbines of 8000 horse-power, while a third and fourth unit will be added later should the demand warrant it. A step-up transformer station has been erected here, where the electric current generated at 6300 volts can be transformed up to a pressure of 66,000 volts. The overhead transmission line runs hence to the main sub-stations at Haifa and Jaffa, where the pressure will be stepped down to the values required for the distribution in the towns and corresponding districts.

The second power-house will be erected at Abadieh, some 5 miles above the site of the first station, when the requirements for power approach the maximum capacity of the first station. The penstocks of this second power-house will be fed by the flow from the Sea of Galilee.

To ensure the waters of this lake being maintained at a level to provide the flow, the waters of the Yarmuk will be diverted into the Sea of Galilee. This will mean that the flood waters of the Yarmuk now going to waste will be tapped and stored. The Jordan outlet will then be dredged to a depth of 4ft. to 20ft., so as to conduct all the waters, both of the Yarmuk and the Jordan, stored in the lake, through the turbines of both the Jordan power-houses at Abadieh and Jisr-el-Mujameh. This second power-house will be equipped with plant of the same type and capacity as the first.

The third power-house will be situated to the north of the Sea of Galilee, and the turbines there will be driven by the waters of the Jordan, the fall of the stream in its course of some 12 miles between Lake Huleh and the Sea of Galilee being no less than 600ft.

The power station there will be close to the old Roman bridge called Jisir Banah Yakoub (Bridge of Jacob's Daughter), so-called from the tradition that it occupies the site of the ford by which the Patriarch sent his family over the Jordan when he lingered behind to engage in that famous wrestle "until the break of day," which resulted in the change of his name to Israel.

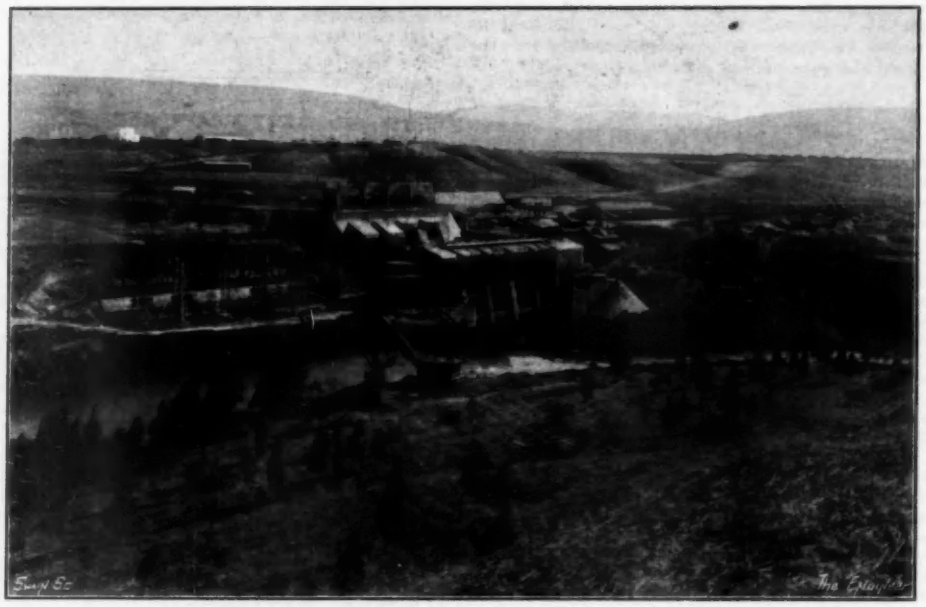
These three power-houses, all of which will be operated by the waters of the Jordan and its tributaries, will constitute the first stage of the project for the electrification of the Holy Land.

The second and third power-houses will be at a later date interconnected with the first one. The further development of the transmission scheme will go along the Jordan valley, and will link on to the Jaffa sub-station from the east, thus giving the possibility of supply to any point on both sides.

Fuel power stand-by stations forming an important element in assurance of the continuity of the supply of electric energy have been erected in Jaffa, Haifa, and Tiberias. These stations have an output of 1000, 1200 and 500 horse-power respectively. They have served the useful purpose of satisfying existing electrical needs, and it is to their existence that the main part of the industrial development of the country in the last few years is due.

This scheme for the electrification of the Holy Land is designed to cover the needs of the whole country. In the near future, it is hoped, every city, town and agricultural settlement will be able to obtain electrical energy. Furthermore, the Government will regulate the charges and cheap power should be the result. It should prove an impetus to general development of the country.

The promoter and owner of the scheme is the Palestine Electric Corporation, of which Mr. P. Rutenberg is managing director and chief engineer, and the Marquis of Reading the chairman. Some views illustrating the scheme will be found on page 348.



JISR-EL-MUJAMEH POWER HOUSE ON THE JORDAN

It discharges over 5,000,000 tons of fresh water into the Dead Sea daily, and up to the present this enormous head of water has not been utilised in any way. It is now not only being harnessed for power purposes, but for irrigating vast unproductive areas in the Jordan valley for the cultivation of cotton and tropical fruits. Experiments have shown that in the hot Jordan Valley the cotton plant changes its character of an annual herb into that of a perennial bush.

The first stage of the scheme centred about the Sea of Galilee. As a natural storage reservoir, with an area of 173 million square metres, and an available volume of one milliard cubic metres, this lake formed the main basis for the regulation of the flow of the river Jordan. The work comprised the utilisation of the fall of 50 m. between the Sea of Galilee and Jisr-el-Mujameh. Topographical and geological conditions rendered it expedient to divide this fall into two parts, one half to be developed at Abadieh, and the other at Jisr-el-Mujameh. Abadieh lies some 2½ miles south of the lake and Jisr-el-Mujameh 7 miles. Jisr-el-Mujameh is the site of the completed power-house.

While the work was in progress at Jisr-el-Mujameh a large construction camp arose, and the settlement was given the name of "Naharaim" (Two Rivers). Some 600 workmen were accommodated here, and everything was done for their comfort. They took their meals in a spacious dining-room, which was run by the company, while, in addition, there were reading and recreation rooms. The sleeping quarters were concrete bungalows specially designed to counteract the heat, for, as this spot lies 700ft. below sea level, it is inclined to be very hot in summer. Workshops were constructed, rails laid, and the necessary machinery and plant collected for carrying out the work. A temporary power-house generating

Institution of Mechanical Engineers.

AT the meeting of the Institution of Mechanical Engineers held in London on Friday evening of last week, March 20th, Mr. Rupert S. Allen and Mr. W. E. W. Millington presented a paper entitled "Modern Methods of Raising Water from Underground Sources." We begin a reprint of the paper elsewhere in this issue. The meeting was well attended and the discussion was satisfactorily sustained.

Mr. William Reavell criticised Mr. A. W. Purchas' figures—quoted by the authors—for the lift and submergence of air-lift pumps. British practice, he said, was not at all in agreement with those figures. In this country the submergence was usually equal to the lift increased by about 30–40 per cent. British practice therefore agreed with Purchas' figures when the lift was about 200ft. At lesser lifts the submergence usually adopted was less than that given by Purchas and at greater lifts it was commonly greater. He agreed with the authors that the air-lift pump did not show a high efficiency. At the same time, as the authors pointed out, it was capable of supplying a larger quantity of water from a given bore-hole than any other type of pump. To provide the requisite amount of submergence, the bore-hole might

have to be deeper than with other types of pump, but because of the high capacity of the air-lift pump, the bore-hole for a given supply of water could be made smaller in diameter. The air-lift pump had no working parts, and did not contaminate the water. It was quite possible that the total cost of installation of an air-lift pump, when the decreased diameter of bore-hole was offset against the greater depth of the hole, might be less than that of any other form of pump equipment for the same quantity of water.

Mr. W. J. Marshall remarked that testimony to the progress which had been made in pump engineering was to be found in the fact that thirty or forty years ago no one would have dreamed of placing a machine running at 1000 r.p.m. at a depth of 300ft. or more below the ground, where it could not be inspected at work. He asked for information concerning the cost and time required to remove from the bore-hole a centrifugal pump of the type described by the authors, to overhaul it, and to put it back again. On the blackboard he sketched a novel type of pump which, he said, was suitable for deep wells. This pump was driven by an A.C. motor directly coupled to, and immediately above, it, the motor working down the well and being enclosed in a form of diving bell.

Mr. W. A. Dexter thought that the scope of the paper might have been usefully enlarged if the authors had devoted more attention to an examination of the relative advantages of reciprocating, centrifugal, and air-lift pumps, the circumstances under which one or other was preferable, and the best form of drive—oil, steam, or electric. He suggested that it would be an excellent thing for all concerned if an effort were made to standardise the diameters of bore-holes. The authors held that if running costs were of prime importance, it might pay to install a reciprocating pump in spite of its high capital cost. He thought that they could have in mind only the driving costs, and not the maintenance costs. If, as was in nearly every instance the case, the water contained sand and grit, pitting and wear were bound to occur on the valve seats and faces of a reciprocating pump, and, as a consequence, there would be a rapid deterioration in the pump efficiency. He knew of one case in which the maintenance charges for a reciprocating pump installation were so high that the plant had been replaced by a centrifugal pump at a cost less than the maintenance charges for the reciprocating pump taken over two years. He held that it was certainly advisable to fit a strainer at the end of the suction pipe to exclude solids that might jam in the pump. He did not, however, favour a fine-mesh strainer, the blocking up of which would create troubles worse than those which it was intended to eliminate.

Criticising the shaft couplings illustrated in Fig. 10 of the paper, Mr. Dexter remarked that type A was admirably adapted for easy dismantling after long submergence in water. After dismantling and reassembly, it maintained the original overall length and alignment of the shaft. Type B was good, but it offered some resistance to the flow of water past it, and it might be difficult to ensure a good fit at the retaining collars. Type C could not be relied upon to give good alignment. Types D and E, with tapered seatings for the shaft ends, presented a difficulty in securing that the seatings would be true to the same axis and, in addition, if the coupling were made and broken many times the shafts would be drawn into the coupling to an increasing extent, and the overall length would be upset. The foot valve illustrated in Fig. 3 was of a very poor design, and exhibited an excessive friction loss. A valve of pear-shape would be much more efficient. In Figs. 4 and 12, a cooling coil for the oil supply to the thrust bearing was shown at the top of the rising main. He argued that that position for the coil, right in the flow of the water, was a very bad one. Dealing with the design of bearings for the pump shaft, he said that in his experience rubber and lignum vitæ were equally good if the water were clean. If, however, the water contained the least trace of sand, then rubber bearings were distinctly advantageous. His firm had found that the rubber should not be too hard, and that it was best arranged in the form of longitudinal strips dovetailed into a metal bush with good waterways between the strips. An inner tube, whereby clean water could be supplied to the bearings for flushing purposes, was not, in his opinion, entirely necessary. Such a tube would, however, have the advantage that by enclosing the shaft, couplings and bearings, it helped to lower the water friction losses.

Mr. C. F. Bekenn asked the authors to say what was the maximum distance below the surface at which a centrifugal type of bore-hole pump could be placed. The authors had suggested that a foot valve at the end of the suction pipe might be regarded as on the whole undesirable. He, however, held that it was a desirable feature, for if the water ran back out of the rising main the bearings might run dry. He agreed with Mr. Dexter that the design of foot valve shown in Fig. 3 was a very poor one. The driving arrangement shown in Fig. 4 contained a definite fault in that there were no outside bearings for the bevel gear wheels. In that respect the arrangement shown in Fig. 11 was to be preferred. He did not agree with the authors' criticism of the non-overloading type of impeller. Discussing the shaft couplings illustrated in Fig. 10 of the paper, he said that design E had originated abroad. A good modification of it, making use of only one taper end, had been employed in this country. Rubber-lined bearings, he remarked in conclusions, were stated by those who made them to be unsuitable for shafts enclosed in tunnels in which the flow of water was insufficient to flush out the sand.

Mr. Lupton said that while the authors had shown a gratifying absence of bias in the treatment of their subject, they had not avoided making invidious comparisons. They stated that the overall efficiency of some centrifugal bore-hole pumps which had been constructed had been found to be from 50 per cent. to 70 per cent. according to the size of the installation. Were those efficiencies calculated on the basis of tank tests, or with the equipment actually at work in the bore-hole? A tank test would give a high value to the efficiency, because there would be no loss of head in the rising main and no loss of torque caused by the skin friction of the water against the driving shaft. Further, there would be no loss corresponding to the water estimated at about 5 gallons a minute which had to be sent down through the bearings of the shaft for flushing purposes. He argued that too little attention was given in practice to the question of efficiency. The tendency was to cut down installation costs and let the rest take care of itself. Comparing reciprocating and centrifugal bore-hole pumps he said that, taking electricity at a half-penny per unit overall charge, assuming that the driving motor had an efficiency of 90 per cent. and allowing for amortisation over a period of 15 years, he found that a reciprocating pumping plant, with an efficiency of 85 per cent., would show an annual saving of £75 per water H.P., as compared with a centrifugal pumping plant of 60 per cent. efficiency. If an oil engine were substituted for the electrical drive, the difference in favour of the reciprocating type would be just about halved. A free gift of an electrically driven turbine pump, coupled with an injunction to run it, would not be a gift at all, but a definite liability.

Mr. S. E. F. Durham gave some particulars concerning the reciprocating steam engine-driven centrifugal pumps recently installed at the Metropolitan Water Board's Deptford pumping station.

Mr. A. W. E. Bullmore, speaking as a water engineer, testified to the satisfaction which he had obtained from the use of bore-hole pumps of the centrifugal type. He criticised the pump makers for adhering too rigidly to the ideal of a small diameter bore-hole. Water engineers liked the diameter to be as large as they could get it, 14in. to 24in. being the usual range. He, himself, had recently sunk one 6ft. in diameter.

Lieut.-Colonel J. D. K. Restler urged makers of bore-hole pumps to pay increased attention to questions of reliability, simplicity of dismantling and ease of assembly. High efficiency and low cost were not everything in a pump which had to be placed down a deep well and which, if it broke down, might entail serious consequences. The reciprocating concertina-type of pump had much in its favour for long-period working.

Mr. J. P. Le Grand expressed his disappointment that the authors had not given attention to the submersible type of pump. If the motor and the pump which it drove were 500ft. or 600ft. apart, numerous sources for the loss of power were introduced and first costs were made high. In addition, it was essential, if the driving shaft were to work satisfactorily, that the bore-hole should be nearly, if not quite, absolutely vertical. There was only one thing which was more difficult than to sink a bore-hole truly vertical, namely, to bring it back to the vertical once it had started to run off. Submersible pumps were undoubtedly low in first cost and had a high efficiency. The difficulty lay in the production of a satisfactory submersible motor for driving them. Such motors had been produced on the Continent and he did not see why they could not be made in this country. He agreed with the authors that the air-lift pump did not have a high efficiency. His firm had installed one pumping 1000 gallons per minute and had found its efficiency to be about 50 per cent. That was a very high figure, the average being about 33 per cent at low heads and about 15 or 20 per cent. at heads of 200ft. to 300ft.

Mr. T. L. Reed Cooper said that several forms of submersible motors already existed. There was, for example, the Admiralty pattern, which consisted of a squirrel-cage motor with its stator in an enclosure filled with transformer oil and its rotor running in the water. In an older type, the windings were covered with rubber, but the laminæ being exposed to the water suffered from corrosion. The Germans had tried the method referred to already in the discussion, in which the motor was arranged in a diving bell filled with compressed air.

Mr. A. E. L. Chorlton said that the centrifugal bore-hole pump had developed very slowly. The form of the pump was invented by Osborne Reynolds in 1885, and its first application for bore-hole use was made 30 years ago.

Mr. Millington, replying to the discussion, said in connection with Mr. Reavell's remarks, that they had no figures of their own concerning air-lift pumps, and had, therefore, quoted those given by Purchas. The submergence commonly used in British practice might be less than the values stated by Purchas, and the quantity of water greater, but it was to be noted that the actual quantity of water pumped from a bore-hole often depended more on the inflow of water into the bore-hole from the surrounding strata than upon the type of pump employed to raise it. Replying to Mr. Marshall, he said that a pump 100ft. deep, driven by a vertical motor at the surface had been withdrawn, dismantled, reassembled and started up again with the assistance of a limited number of men in a space of 20 hours. The foot valve illustrated in Fig. 3 was not advanced as being a good design. It and the accompanying curve were given only to show what loss of head *could* occur in actual practice at the foot valve. An argument in favour of doing without a foot valve lay in the consideration that if there were none the withdrawal of the equipment from the bore-hole would be facilitated by the fact that the weight to be lifted would not include the weight of water in the rising main. He heartily agreed with Mr. Dexter's suggestion for the standardisation of bore-hole diameters. Mr. Dexter's criticism of the double-cone type of shaft coupling might apply if the coupling were frequently broken and remade. In practice, however, the dismantling of the equipment was not of frequent occurrence, and no alteration of the original alignment or overall length of the coupling was experienced. The position of the oil cooler for the Michell thrust-bearings in the equipments shown in Figs. 4 and 12 was determined by the fact that for the oil cooler to be effective it must not be placed in a region of dead water. Discussing the merits of different forms of shaft bearings, he said that a rubber bearing could give very good service, but it was not necessarily to be preferred to *lignum vitæ*. Experience was definitely against the use of white metal bearings. It was found that any grit in the water became embedded in the white metal and that the bearings were converted into the equivalent of what was known in the shops as a lead lap. The development of a satisfactory submersible pump and motor would, undoubtedly, greatly facilitate pumping from a bore-hole that was not straight. The motor would, however, have to be of the A.C. type and if current of that kind was not available, pumps operated from the surface would still be required.

British Sea Power, 1900—1930.*

By Sir ARCHIBALD HURD.

BRITISH sea power has suffered an eclipse since the opening of the present century. The character of that eclipse and its extent it is the purpose of this paper to examine.

Conditions at sea will never be the same as they were thirty years ago. The balance of population, wealth, and trade has changed. Whereas we were supreme in all the elements of sea power, as well as its arts, in the early years of this century, we are supreme no longer to the same extent.

We may hope, with what confidence we can mobilise, that the eclipse, unlike that sustained in the past by Holland, Spain, Portugal, and France, will prove, in the last analysis, only temporary, for the British Empire is incurably maritime. We are surrounded by the sea—a source of safety and also of danger, and the seas and oceans of the world are the highways of our commerce, as well as the highways of the commerce of the other peoples embraced in the Empire, its Dominions, its Colonies, and its Protectorates. This country, in spite of the resolutions of Imperial Conferences conceding political equality to every self-governing part of the Empire, contains upwards of two-thirds of the Empire's white population, and that population must dominate the destiny of the Empire, in the immediate, if not the ultimate future, by reason of its size, its accumulated wealth, and its acquired experience in finance, commerce, and shipping. Without ships there could be no Empire, and extraordinary folly would have to be exhibited by the Governments of the Empire in future if those ships ceased to be built, manned, and operated by those who over many centuries have become experts in these arts, and have proved that they can build the best and cheapest ships.

The eclipse of British sea power has occurred on the naval side as well as on the mercantile side, and it is in the former respect that the movement has been most notable.

I. THE ROYAL NAVY.

In glancing back thirty years we are brought into the atmosphere of the South African War, when the British Fleet "kept the ring." There was no Power or combination of Powers which was prepared to try conclusions with the mighty naval forces which this country supported, with a prestige unsurpassed.[1] It led the world in the design of battleships, and, if not as conspicuously, of cruisers also, as well as in excellence and cheapness of construction, with the result that welcome orders for men-of-war were obtained from foreign Powers.[2] Even "Brassey's Annual," jealous as it was of the power of the British Fleet, could not but confess that in large armoured ships the British Fleet was above the Two-Power Standard, for at that time the two navies of France and Russia were the next most powerful at sea. The comparative fighting strength was, owing to a variety of circumstances, strategical, economic, and racial, much greater than any statistical summary could indicate, for sea power is a matter of men as well as of ships. The position in regard to cruisers was also consolatory. There were 141 cruisers in the British Fleet as compared with 75 under

* Institution of Naval Architects, March 25th, 1931. Abridged.

[1] In the spring of 1900 this country had in course of construction no less than fourteen first-class battleships, as against two for France, seven for Russia, nine for Germany, seven for the United States, four for Italy, and two for Japan.

[2] In 1910 the exports of foreign men-of-war were valued at as much as £4,896,500.

the flags of France and Russia. The superiority of the British Navy in smaller auxiliary craft was even more considerable. All over the world the British Fleet was beyond challenge by any probable combination of Powers.

The British Fleet pervaded the seas and oceans of the world. It was so strong in ships and men that it could afford to dissipate its forces far and wide. The trader and the shipowner and the colonist had the assurance, though wireless telegraphy was a development of the future, that nothing untoward could happen without some ship of the British Navy being speedily on the spot. The British Fleet was regarded as the essential support of our diplomacy and our trade. This world-wide scheme of distribution was impressive, if it were not very efficient from the point of view of war. There was, however, little serious thought of war until the closing years of the nineteenth century, and this country and the whole Empire reaped the advantage in high prestige which flowed from this world-wide showing of the flag. It may, indeed, be claimed that in the period rendered notable by the South African War, the British Fleet reached its maximum development as an agent of civilisation, standing impressively on guard on all the trade routes, supporting the standard of culture to which this country had attained, checking piracy, suppressing slavery, and charting the great maritime highways of the world's commerce.

The South African War was a vindication of British sea power—the ship of war and the ship of commerce. It was carried on 6000 miles from the base of supplies. Transports and store ships continued throughout that long-drawn-out struggle to pass without interruption between the Mother Country and the bases of operation. This triumph of sea power was not without its influence on the naval policy of other countries. The United States, which had emerged from its war against Spain with distant territorial possessions and quickened naval ambitions, took note of the events in virtue of her self-imposed *rôle* as defender of the Monroe Doctrine. Japan—"the Great Britain of the East"—was not uninfluenced by the moral to be inevitably drawn from the British success, nor could it view without some concern the active naval construction which was beginning in American shipyards. Two first-class navies were thus springing up, both overlooking the Pacific, where hitherto British strength had reached at least a Two-Power Standard.

But a third first-class navy was also arising in Europe—that of Germany. The British antagonism aroused by the Kaiser's notorious telegram and the German irritation springing from the arrest of the "Bundesrath," brought home to the rulers of Germany that country's naval impotence. Under the enthusiastic leadership of the Kaiser, a grandson of Queen Victoria and an Honorary Admiral of the Fleet in the British service, it was determined that a first-class fleet was essential if Germany were to secure her place in the sun. The comparatively modest programme which had been authorised in 1898 was brushed aside in 1900, and an Act passed which practically doubled the naval establishment.

In this way the race between this country and Germany for naval supremacy began, with the United States and Japan developing their strength in extra-European waters. From the opening of the century to the outbreak of the war we laid down 53 capital ships and Germany 38; 21 armoured cruisers and Germany 6; 51 other cruisers, as well as 8 scouts, and Germany 32; 211 surface torpedo craft, and Germany 132. In 1920, if war had not intervened, Germany would have had 41 capital ships, 40 cruisers, 144 destroyers, and 72 submarines.[3] Whether or not that would have been a fleet superior to the British Fleet must be a matter for speculation. In the spring of 1914, the British Government had indicated that it was intended to reduce this country's naval expenditure, since it was held in many quarters that war with Germany was not an event which need be contemplated.

In the summer of 1914 the German Army dictated policy to the German Navy, while the latter's methodical building plans were still incomplete, with the result that the British Fleet seized something in the nature of a command of the sea which was, in spite of submarine and mine, the essential factor in the victory which was sealed after years of struggle such as mankind had never before experienced. The British people had made themselves, at enormous sacrifices, supreme at sea in a military sense. During the war 2,000,000 tons of displacement of men-of-war were added to the British Fleet.[4] Though heavy losses were sustained at sea, this country's Navy emerged from the struggle superior in a measure never before recorded in history. Germany as a first-class Naval Power had disappeared; the Russian and Austrian navies were no longer of any account; the French and Italian navies had necessarily been neglected owing to the military effort those countries had had to put forth. No other first-class navy was left in European waters.

In these circumstances the first task of the Admiralty was to cut down the British Fleet in the interests of economy. It was engaged in this task when an invitation came from Washington to a conference, with a view to the limitation of naval armaments, for the Americans had committed themselves to a great expansion programme in 1916, when irritation in the United States, by reason of this country's acts as a belligerent, was at its highest, and Japan had reacted to the American expansion. It is unnecessary to recall at length the course of events. Their outcome is that the trident is, in future, to be held jointly by the British and American peoples, though there is obviously an enormous disparity between their naval needs.

There has never been an explanation of the failure to maintain our traditional Two-Power Standard in the post-war years. It was based on the strength of the two next strongest European fleets. It may be suggested that it would have been wise to go on our way without reference to the United States or Japan, the latter then our faithful ally. We should have been saved from misunderstandings, present and future, for the London Naval Treaty promises to be a continual source of trouble. If we had taken this course we should have retained our freedom of action and the Dominions would have also been free to develop naval forces, while Japan would still be our ally. Now all the peoples of the British Empire, with a population of 450,000,000—four times that of the United States—are constrained by the all-embracing London Treaty.

Under the new Treaty we have agreed to scrap five capital ships which would otherwise have remained on the active strength till December, 1936; we have agreed to reduce the number of cruisers for the period of the Treaty from 70 to 50, besides limiting the number of large cruisers; we have also consented to cut down the programme of destroyers from at least 200,000 tons to 150,000 tons; and we have agreed to a programme of submarines of 52,700 tons in place of one of 90,000 tons. The reduction of tonnage of the Fleet as a whole is to be carried further in accordance with the provisions of the London Treaty. Whereas the tonnage was 2,160,326 in August, 1914, it will be only 1,151,450 in December, 1936, a reduction of 46·7 per cent., with a decline in the personnel of 37·7 per cent. On the other hand, over the same period, the fleet of the United States will show an increase of tonnage of 30·1 per cent. and that of Japan an increase of 36·7 per cent., while Italy will reach a strength 18·7 per cent. greater. In the case of France, the Navy has fallen from 746,214 tons in August, 1914, to 463,770 tons to-day, but in December, 1936, it will have reached a figure of 640,000 tons.

The position to-day is that, after much talk, which has not conduced to a peaceful atmosphere, the British Fleet remains on something higher than a Two-Power Standard as that standard was interpreted in the past in relation to European fleets only; and its relative strength to the new first-class fleets which have been developed since the beginning of the century has been fixed by agreement. Its position in European waters is at least as strong as it was in 1900, but it has surrendered that margin of strength which enabled it to support British prestige and trade in the outer seas, and the hands of all the British peoples are tied for five years at least. Great Britain is still the supreme sea Power in the focal areas of our sea trade in European waters—for the time being. On the other hand, the British Empire, every part of which is also bound by the Treaty, is not only not supreme at sea, when account is taken of the most elementary strategical considerations, but is in a position of inferiority. The Empire, so far as naval force can defend it, now exists on sufferance. That is the disturbing situation at the moment, and yet those who rule the destinies of the Empire are apparently content.

The reactions of this surrender are not to be judged yet. All that is apparent is that the reduction of British naval strength has struck a blow at our basic industries as well as a large number of ancillary trades, for a man-of-war carries officers and men who must be fed and clothed—men who have the everyday needs of ordinary men ashore. The nation has not profited by the policy of naval economy—Table I. When, in earlier days, there was talk of "the burden of armaments," the bait was that a smaller fleet would mean lower taxation and, consequently, more prosperous trade and commerce. Our competitive power would be increased. That has not been our experience. Taxation has mounted up as naval power has declined. The revenue expenditure on national and local services is now approximately eight times what it was at the beginning of the century and four times what it was on the eve of the war. The savings on the Navy and other essential services have been dribbled away. Money which would have been spent on work is being dissipated in unemployment pay, while the ability of the maritime industries to compete for foreign orders has been weakened to the advantage, in particular, of Italian and French shipyards.[5]

TABLE I.—*Average Annual Expenditure on British Naval Construction during Five-year Periods from* 1900 *to* 1930.

Period.	Private contractors.		Royal Dockyards.		Total.
	£	Per cent	£	Per cent	£
1901–05	7,394,000	72·7	2,776,000	27·3	10,170,000
1906–10	7,249,000	80·1	1,800,000	19·9	9,049,000
1911–15	14,558,000	85·6	2,443,000	14·4	17,001,000
1916–20	44,106,000	93·5	3,074,000	6·5	47,180,000
1921–25	2,959,000	58·9	2,060,000	41·1	5,019,000
1926–30	6,504,000	76·3	2,019,000	23·7	8,523,000

There are two sides to the balance sheet recording the gains and losses of this country which have flowed from the limitation of our naval armaments, and if account of them were taken by psychologists, industrialists and economists, free from all prejudices, it is probable that the losses would be held to have far exceeded the gains. When the British Fleet has been strong this country has been prosperous and the British Empire generally contented and happy.

A weak British Fleet does not necessarily mean peace, as history records, and, as is shown in Table II., the British Fleet is weak to-day and will become weaker:

TABLE II.

	British Empire.		United States.		Japan.		France		Italy.		Germany.	
	Built.	Building.	Built.	Building.	Built.	Building.	Built.	Building.	Built.	Building.	Built.	Building.
Capital ships ..	15*	—	15*	—	9*	—	3†	—	2†	—	1‡	1‡
Aircraft carriers	8	—	4	1	5	1	1	1	1	—	—	—
Cruisers	53	5	19	21	37	4	16	5	13	11	8	1
Surface torpedo craft	148	26	218	—	105	10	54	19	65	13	27	—
Submarines ..	59	7	107	3	67	4	54	56	40	30	—	—

* Strength according to the London Naval Treaty.
† France and Italy have liberty to lay down three ships and two ships respectively under the London Naval Treaty.
‡ These are ships of only 10,000 tons displacement.

II. The Merchant Navy.

The Merchant Navy, as well as the Royal Navy, has suffered a partial eclipse since the opening of the present century, and the cause has been much the same. We have witnessed the awakening of other nations to a realisation of the value of sea-carrying power as an auxiliary to sea-fighting power, and as an economic instrument. But that is not the complete explanation, though it goes some way to expose the motive of the Americans. In other cases, a variety of causes has been at work. While the war was in progress the impression prevailed that shipowners, and especially British shipowners, were making a good thing out of the struggle, and that shipbuilders and marine engineers were sharing in the benefits. Again, the narrow nationalism which has found expression in higher and yet higher tariffs has supported the suggestion that each country should carry, if not all, at any rate the larger proportion of its sea-borne trade, as though it were possible to differentiate between the claims of the buyer and the seller of goods in the matter of transport. As deaf ear has been turned to the impregnable truths that the seas are all one and that the greatest good of the greatest number lies in freedom of access to the world's freight markets, with efficiency and cheapness of service as the basis of a healthy competition, on the important trade routes, even if, at heavy cost to producers and consumers, the coastal trade be reserved to the national flag. Whatever the causes, and they might repay closer examination, the British Merchant Navy has suffered a partial eclipse, because other nations have added to their merchant fleets by various expedients which may be loosely described as "navigation laws."

From the South African War the shipping of this country obviously profited, as a good deal of tonnage was required for use as transports and store-ships. But from 1904 onwards shipping experienced one of the recurring cycles of depression; and that depression lasted longer, was more widely spread, and was more severe than usual. But from 1908 international trade began to improve and freights slowly advanced up to the latter half of 1912, after which they began to recede until the outbreak of war. The efficiency of managements ashore, in association with the building of new and more efficient ships and a general betterment of the crews, had placed the Merchant Navy, including Dominion ships, in a position of great strength in 1914, as subsequent events were to prove. It embraced 42·8 per cent. of the world's tonnage, and the shipyards were busy supplying tonnage not only for service under the British flag, but for service under foreign flags.[6]

British shipowners were carrying:[7]

(1) Practically the whole of the coasting trade of the United Kingdom.
(2) Ninety per cent. of the trade between the United Kingdom and the Empire.
(3) More than one-half the trade between the United Kingdom and foreign countries.
(4) About one-half of the remaining trade of the world.

Then came the familiar, and bitter, war experience of most of us. It may be said without a suggestion of exaggeration that British shipowners, shipbuilders, and marine engineers, as well as ship repairers, made an essential contribution to the Allied victory. Without British ships, which supplied the needs of this country and supplemented the resources of our Allies, the war fleets could not have continued their functions, munitions would have been in short supply for the navies and armies, the population of this island, as well as the populations of France and Italy, would have been confronted with starvation, and Germany would have won the war, even though the High Seas Fleet had not been defeated—had, in fact, remained locked up in its home ports.

The first task of British shipowners as soon as the Armistice had been signed was to make good their heavy losses. The situation was an embarrassing one, for their freights had been controlled and their profits subjected to onerous taxation, whereas neutral shipping, as well as the shipping of some of our Allies, for a varying period, had received high war freights without having to pay exceptional taxation. It was fortunate for this country and its shipping industry that in earlier years shipowners had built up large reserves. If that policy had not been pursued, the restoration of British shipping could not have been carried out without State aid, for it is a fallacy to think that the British shipping industry made enormous profits during the war.

The British Merchant Navy emerged from the war weakened by losses amounting to 7,830,855 tons, and without adequate funds for making good those losses, except by drawing on pre-war reserves. It has been calculated by Sir Norman Hill that the replacement cost exceeded the insurance money received by £137,000,000.

Crippled by the war, the British shipping industry has done little more than replace the tonnage destroyed. The progressive expansion of the Merchant Navy was inevitably checked, by the mistaken policy pursued by successive Chancellors of the Exchequer during and after the war. The growth of the merchant navies of other countries, on the other hand, has proceeded at an accelerated pace.

It has been suggested that British shipowners have overbuilt. That criticism is not borne out by figures given in Lloyd's Register. If we ignore the tanker tonnage, which is a new development unrelated to general international trade, and confine attention to vessels devoted to the carriage of passengers and merchandise, we reach the arresting conclusion that if British and foreign shipping had continued to increase in the same proportion as in the period 1900 to 1915, the British tonnage afloat to-day would amount to 29,680,000 tons, or 8,701,000 tons more than it is, while foreign tonnage would be 50,298,000 tons, or 9,205,000 tons more than it is. In other words, the total tonnage of the world, excluding tankers, would amount to 79,978,000 tons, or 17,906,000 tons more than is now either at sea or tied up in idleness in the harbours of the world. If, moreover, foreign countries had shown the same restraint over the last fifteen years as British owners have done, and had only increased their fleets by the same percentage, the total tonnage in existence would have been some 13,500,000 tons less.

The two broad facts that have to be borne in mind are, first, that as compared with 1913, there has been only a

[3] First Lord of the Admiralty.

[4] Sir Eustace Tennyson d'Eyncourt, Institution of Naval Architects, Spring Meetings, 1919.

[5] Brassey's "Naval and Shipping Annual (1931), page 36.

[6] The exports of new merchant ships were valued at £8,409,430 in 1913.

[7] Departmental Committee on the Shipping and Shipbuilding Industries, 1918, Cd. 9092.

small increase in British tonnage for the carriage of passengers and merchandise; and, secondly, that the expansion of tonnage under foreign flags has amounted to 14,000,000 tons. Does that movement reflect a falling off in the share of the world's trade which British merchant vessels are carrying? That is a question which it is difficult to answer owing to the failure of several countries, notably our own, to prepare statistics of the volume as distinct from the value of trade. To some extent the Chamber of Shipping has come to our rescue with figures of idle tonnage, but they are only approximate. They do not differentiate between passenger ships, cargo ships, and oil tankers. This country had approximately 2,500,000 tons laid up on January 1st last out of an aggregate of just over 7,500,000 tons for the whole world, so that our proportion of idle ships was practically the same as our percentage of world tonnage. If regard were paid to the laying up of nearly 4,000,000 tons by the United States, the proportion of British shipping would appear in even a worse light. If we were holding our pre-war position as ocean carriers, the proportion of British tonnage tied up should obviously be considerably less than it is, since the British merchant navy has expanded so little, while many foreign navies have expanded so much.

III.—The Future of British Sea Power.

The mantle of a prophet is not one to be adopted lightheartedly, for if the prophecy be correct it will certainly be forgotten, but if it be incorrect its author will become the target of criticism. There are, however, certain factors which, in their reaction on British sea power, may prove favourable to our interests, but it is well to use the word "may" rather than the word "will."

So far as the Royal Navy is concerned there is little immediate hope unless the main provisions of the London Treaty are rendered void by the shipbuilding activity of Powers which are not parties to them, such as France and Italy, washed by the waters of the Mediterranean, the life-line of the British Empire. It will be recalled that Part III., with which only the British Commonwealth of Nations, the United States, and Japan were concerned prior to the recent Franco-Italian agreement, specifies the maximum tonnage in cruisers, destroyers, and submarines—see Table III.

TABLE III.—*Tonnage under the London Naval Treaty.*

	Commonwealth of Nations.	United States.	Japan.
Cruisers—			
Guns heavier than 6·1in.	146,800	180,000	108,400
Guns not exceeding 6·1in.	192,200	143,500	100,450
Destroyers	150,000	150,000	105,500
Submarines	52,700	52,700	52,700
Total	541,700	526,200	367,050

A safeguarding clause—Art. 21—permits additional construction if the national security of any of the three Powers is affected by new construction by any Power not a signatory to this part of the Treaty. It is this article which governs the naval situation so far as the British Empire is concerned. But that clause is in the background, and at the moment there appears to be no prospect that, apart from battleships, the strength of the British fleet will reach the London Treaty standard by 1936. Unless large orders are speedily given out it will be short of twelve modern and efficient cruisers, besides a much larger number of destroyers and submarines. The British fleet is suffering an eclipse, and apparently the country is indifferent, failing to realise its increasing peril.

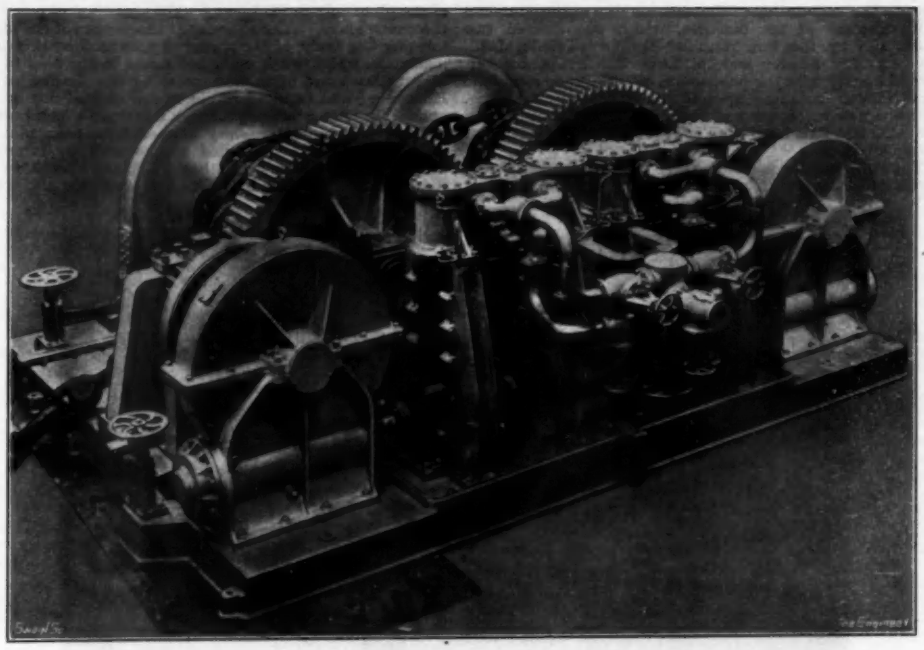
When we turn from the Royal Navy to the merchant navy, the position is also uncertain. The conditions are abnormal owing to the extent to which shipbuilding is being encouraged by direct or indirect State aid in the United States, France, Italy, and other foreign countries. There is no suggestion that these foreign ships are needed, because it is obvious to everyone that there is already too much tonnage of all descriptions afloat, with the result that more vessels of every nationality are tied up in idleness than ever before, and there is scarcely a ship in service under any flag which has its full complement of passengers or its holds more than half or one-third occupied. How long this policy of spoon-feeding will be pursued at the expense of the taxpayers of the countries concerned it is impossible to foresee. There is no precedent to aid in forecasting the course of events. Nationalisation of shipping having proved a conspicuous failure, another experiment is being tried—subsidies. It can be supported by the argument that it ensures work when work is urgently needed. It certainly ministers to the spirit of nationalism, which is one of the legacies of the war. Those two factors are not to be ignored. But, on the other hand, this State-aided activity will prove a burden on other national industries. How long will those burdens be regarded with indifference at a time when in all parts of the world men and women are feeling the pinch of increasing poverty? If State-aided shipbuilding persists other countries may be forced by their own necessities to fall into line with those who are denying the first principles of the economic law which in earlier years of this century were honoured everywhere.

If we pass from these broader considerations to a final reivew of the British position the conclusions reached are not without consolation. In the first place, there are only about 400,000 tons more tonnage in passenger and cargo-carrying ships under the British flag than in 1914, and year by year, owing to age, ships are becoming obsolete and will have to be replaced by new and presumably more efficient tonnage. How far, on the other hand, the decrease in the transport of coal, in the past our bulkiest export, and, on the other, the increase of foreign merchant navies may check that replacement for a time, it would be difficult to prophesy. In the second place, well-established British shipowners have shown that they have lost none of their cunning, but they are heavily handicapped by higher wages and other costs. In the third place, those concerned with shipbuilding and marine engineering in this country, weighed down by the burdens imposed on them owing to the extensions which were necessary during the war have exhibited their ability to confront the future manfully: first, by launching half the world's tonnage in recent years; and secondly, by taking energetic measures to eliminate the redundant capacity of the establishments in this country, in order to place the industry once more on an economic basis.

There is one last and permanent factor. We, as islanders, are shipmen, living at the centre of a world-wide oceanic Empire. We have inherited great traditions as well as great skill and experience in the designing, building, and manning of ships.

LARGE WINCH WINDLASS FOR S.S. "TRIONA"

CLARKE, CHAPMAN AND CO., LTD., GATESHEAD-ON-TYNE, ENGINEERS

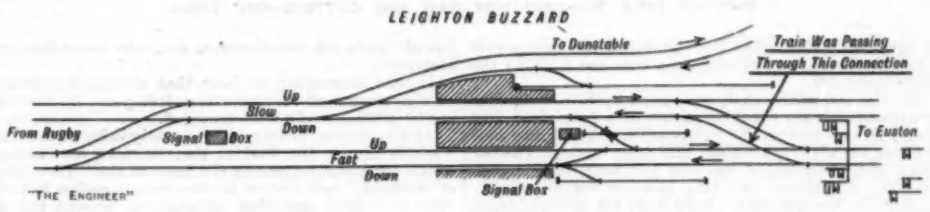


An Unusual Mooring Winch Windlass.

The British Phosphates Commissioners' vessel s.s. "Triona," built by Harland and Wolff, Ltd., which proceeded on her trials on March 21st, has, as one of her functions, the picking up and laying of moorings under somewhat difficult conditions. The island from which the phosphate deposits are obtained has but little foreshore, and the water deepens rapidly. The only moorings obtainable take the form of buoys secured to the rapidly shelving submerged portion of the island by chains and cables in very deep water. It has been found necessary to fit the ship with winch windlasses specially designed for laying and picking up these mooring cables. When picking up, the cable has to be broken away from its hold. The gear was supplied by Clarke, Chapman and Co., Ltd., of Gateshead-on-Tyne, and the winch, of which a photograph is reproduced herewith, is fitted under the forecastle deck and two floating barrels are arranged in line with the centre line of the vessel. A separate engine, with 12in. by 12in. cylinders, drives each of these barrels through worm and spur gearing. The barrels are 3ft. in diameter at the waist, and 4ft. in diameter at the ends and 6ft. long. They are not, however, fitted with whelps, but are suitable for working with wire 8in. in circumference or with 2¼in. to 3in. diameter stud link cable. Each drum can exert a pull of 25 tons at the rate of 40ft. per minute; the total pull is, therefore, 50 tons. The steam pressure is 100 lb. per square inch. On test the gear is stated to have lifted a load of 100 tons acting directly on to the barrels. A powerful screw-operated brake is fitted to each barrel, and an auxiliary brake acts on the intermediate shaft.

Fatal Railway Accident at Leighton Buzzard.

On Sunday last, the 11.30 a.m. London, Midland and Scottish express from Euston to Glasgow and Edinburgh—erroneously called "The Royal Scot" in the newspapers—had occasion, owing to engineering operations on the down fast line north of Leighton Buzzard, to be diverted from the down fast on to the down slow line at the south end of that station. That was done by means of the cross-over junction shown on the accompanying diagram; but when the train had apparently reached the down slow line the engine was derailed and turned on to its right side. The train consisted of, we believe, fourteen coaches, and the first four were more or less destroyed. Two passengers were killed and one has since died; the driver, fireman, and one of the restaurant car staff also were killed. Colonel Mount, of the Ministry of Transport, visited the scene of the accident on Monday and the Ministry of Transport inquiry was opened yesterday—Thursday. The coroner's inquest was opened on Tuesday last, and after evidence as to identification, was adjourned until April 16th. The cause of the accident is at present unknown. One possible cause may, however, be ruled out; it could not have happened at the facing points, as the whole of the train passed safely through them, and, moreover, except the wrecked coaches, the vehicles kept in line.



B.E.S.A. SPECIFICATIONS.

STEEL CYLINDERS.

The British Engineering Standards Association has just issued specifications for "Low Carbon" Steel Cylinders for the Storage and Transport of "Permanent" Gases and for Steel Cylinders for the Storage and Transport of "Liquefiable" Gases. These specifications are based on the summary of recommendations for the storage and transport of liquefiable and "permanent" gases included in the first and fourth reports of the Gas Cylinders Research Committee of the Department of Scientific and Industrial Research.

The "Low Carbon" Steel Cylinder Specification (No. 400) has been prepared for the storage and transport of such gases as atmospheric air, oxygen, nitrogen, hydrogen, &c., which, at the working temperature and maximum pressure of 120 atmospheres, remain in a gaseous state in the cylinder.

The "Liquefiable" Gas Cylinder Specification (No. 401) has been prepared for the storage and transport of such gases as sulphur dioxide, ammonia, chlorine, methyl chloride, ethyl chloride, hydrocyanic acid, phosgene, carbon dioxide, nitrous oxide, ethylene, &c., which have relatively high critical temperatures, and which are generally reduced to the liquid condition by the pressures used in charging them into the cylinders.

The specifications include particulars of tensile, impact, flattening and hydraulic stretch and pressure tests, together with a formula for the determination of the minimum thickness of cylinder walls. These specifications, together with that issued in October of last year, for "High Carbon" Steel Cylinders for the Storage and Transport of Permanent Gases (B.S.S. No. 399) complete the series of gas cylinder specifications which have been prepared by the Association. Specifications are also in course of preparation for Identification Colours for Gas Cylinders and for Gas Cylinder Valves.

Copies of the new specifications (B.S.S. No. 400 and 401–1931) may be obtained from the British Engineering Standards Association, Publications Department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. each, post free.

Opening of a New Billet Rolling Mill.

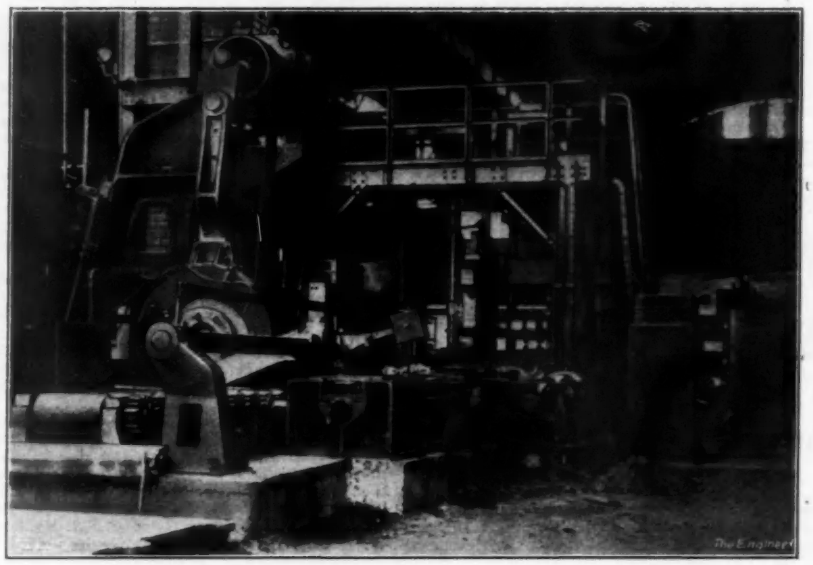
ON Thursday, March 19th, a ceremony was held at the Sheffield steel works of Andrews Toledo, Ltd., to inaugurate a new billet rolling mill recently installed by the company. The installation of the mill is a step in the complete reorganisation of the business, which was started two years ago by the formation of Andrews Toledo, Ltd., from Jno. Hy. Andrew and Co., Ltd. The firm is now connected largely with the production of high-grade steel bars and billets, including special steels of various kinds, and the nature of some of the material may be judged from the fact that much of it is used in the manufacture of aeroplane parts.

The new machine is a 25in. three-high billet rolling mill, constructed by the Brightside Foundry and Engineering

25IN. THREE-HIGH BILLET ROLLING MILL

Company, Ltd. It is driven through gears by a Metropolitan-Vickers 750 B.H.P. three-phase motor, running at 740 r.p.m., which takes power from the Corporation supply. The signal for starting it was given by the Lord Mayor of Sheffield, and an ingot of 60–70 ton carbon steel, about 1ft. square at the larger end, was passed through. It was reduced in nineteen passes with a reduction of area of 10 to 12 per cent. at each pass to a billet 3in. square, which was then hot-sawn into convenient lengths.

After the ceremony an opportunity was provided to see other departments. The steel plant consists of three 20 ton Siemens-Martin open-hearth acid steel furnaces, which are served by a recently erected gas producer plant. The ingots are heated in a new continuous re-heating furnace, electrically operated, in readiness for rolling in



VIEW OF MILL SHOWING HOT SAW AND CUTTING-OFF TABLE

the new mill. The billets thus produced are transported on rail tracks to the bar mills, the wire rod mills, or the billet stock yard.

The wire rod rolling mills are served by two continuous furnaces, which are fired by means of a pulverised fuel plant. In this section the billets are converted into rods for use in the wire rope, needle, and other trades. The bar rolling mill department has not yet been fully reconstructed. At present, two 12in. and one 9in. electrically driven mills are installed. Steel bars for springs, drills, tools, &c., are rolled here.

Perhaps the most interesting department is the spring shop, where laminated springs for motor cars are built up. This shop has been re-organised on mass-production lines, the bars entering at one end and the finished springs being delivered at the other. One of the first operations to be seen in this department is that of forming the longest plate of the spring. Each plate, cut off to the correct length, is placed in a furnace specially arranged to heat the two ends only. The operator takes the hot plates and passes the ends one after the other into a press, which, in three operations, bends them over to form the loop. The accuracy of the fit of the scarf at the end of the loop against the straight part of the plate after the final operation of the machine was particularly noticeable. Two or three strokes of a hand hammer to correct any slight inaccuracies were all that were necessary to complete the operation. Another furnace is arranged to heat the middle of the plate only in readiness for the operation of punching the central hole. The chamfer at the corners of the plates forming the body of the spring is produced by punching machines, which work upon hot metal in the case of the longer plates and upon cold metal for the shorter leaves. Hardening and bending to shape are carried out in one operation. After passing through a furnace which heats it evenly to a pre-determined temperature, each plate is placed on a chain supported at the ends by means of helical springs above an oil bath. A tup curved to the required extent is then brought down on to the plate, and, extending the springs at the end of the chain, forces it below the surface of the oil and bends it at the same time. The bent and hardened plates are dropped into a metal basket and treated together in a salt bath.

A little adjustment of the curvature is necessary before the leaves are finally bound together to form the spring. A permanent set is always found to occur with laminated springs when they are compressed for the first time, and this is impressed upon them before they leave the shop by means of a specially arranged hydraulic press. Finally, each spring is tested for deflection and set in a testing machine designed for the purpose.

Throughout the works control is exercised by the laboratory, which is conveniently situated near the centre. Both raw materials and finished products are carefully tested, while all the furnaces, &c., are controlled pyrometrically.

It was interesting to hear that during the progress of the scheme of reorganisation last year, no less than twelve smoke-stacks were removed.

At a luncheon that was subsequently held, at the Royal Victoria Hotel, Mr. Parker, the chairman and manager of the company, proposing the toast of the "Lord Mayor of Sheffield," said that so far the reorganisation had been very successful, and that although at present the firm only employed four hundred men, it was hoped that that number would be increased in the future as a result of the improvements. In reply, the Lord Mayor, Alderman H. W. Jackson, to whom a silver replica of the trade mark of the company was presented, said that it had given him great pleasure to inaugurate the new plant, and that he was very pleased to hear of reorganisations that led to the employment of more men and the consequent reduction of the unemployment figures in the city. Sir Henry Fowler expressed the thanks of the guests for the entertainment that had been provided.

S.S. Berwindlea—Pulverised Fuel Service Results.

WE recently received from the Berwind-White Coal Mining Company, of 1, Broadway, New York, a summary of fourteen months' service results for the collier "Berwindlea." This ship, it may be recalled, was specially designed for burning pulverised fuel and was built to the order of the Berwindmoor Steamship Company, by the Blythswood Shipbuilding Company, Ltd., of Scotstoun, her triple-expansion steam engines and boilers being supplied by David Rowan and Co., Ltd., of Glasgow, while the pulverisers and burners were designed and built by Clarke, Chapman and Co., Ltd., of Gateshead-on-Tyne. The construction of the ship and her machinery was supervised for the owners by the firm of Esplen and Sons, Ltd., consulting engineers and naval architects, of Liverpool.

She ran her trials on the Firth of Clyde on August 1st, 1929, and after loading a cargo of coal, immediately left for Marseilles, returning to Glasgow in ballast. After carrying a cargo of coal to Montreal, she took up her regular trade, loading coal at Norfolk, Pa., or Newport News, for Havana, with occasional ore cargoes when returning north. Her twelve months' articles expired in September, 1930, when she was sent over to Bremen from Savannah with a cargo of cotton, arriving on October 5th, 1930.

In what follows we give a short description of the ship and her machinery, and an outline of the service results above referred to.

The "Berwindlea" is a single-deck collier, with a long poop covering the machinery space, and with topside water-ballast tanks built on the cantilever principle, in addition to a cellular double bottom. Based on a speed of 10 knots, the anticipated daily consumption was calculated at about 25 tons, and the results over nearly fourteen months' running come out remarkably close to that figure.

Hull and Machinery Particulars.

Hull dimensions :	
Length between perpendiculars ..	390ft.
Breadth moulded	52ft.
Depth moulded	31ft.
Load draught	24ft. 7¾in.
Deadweight	7580 tons
Cubic capacity	335,970 cubic ft.
Bunkers, permanent	624·5 tons
Bunkers, reserve	100·8 tons
Machinery :	
Triple-expansion engines	23½in., 39in. and 65in. by 48in.
Two boilers, single-ended	16ft. 6in. by 12ft. 3in.
Working pressure	200 lb.
Three furnaces to each boiler	
Total heating surface, ...	6140 square feet.
Maximum designed I.H.P.	2300

The usual engine-room auxiliaries are fitted, but as the water ballast amounts to 1884 tons, two ballast pumps, each of 250 tons per hour capacity, are provided to ensure a quick discharge. The pulverised coal firing system was designed and laid out by Clarke, Chapman and Co., Ltd., under the Woodeson patents, and two "Resolutor" mills are fitted, one for each boiler. The average kilowatts consumed per ton of coal pulverised is 16·8, which figure also includes the power absorbed in driving the induced-draught fan. The fineness of grind averages about 86 per cent. through a 200 mesh sieve. The distribution of the coal from each mill is to three furnaces by a ring return main, tapped off at three points. In service no difficulty has been encountered in obtaining exact and equal distribution to the burners, which are of the "Woodeson" patented short-flame pattern. Both the primary and secondary air is furnished by a steam-driven Howden fan, the primary having five passes through the corrugated Howden air-heater, giving an average temperature at the mills of 530 deg. Fah. The secondary air makes four passes, and reaches the furnace fronts at a temperature of 450 deg. Fah.

Résumé of 14 Months' Work.

Total distance steamed	57,230 miles
Number of cargo-carrying passages ..	29
Number of ballast-trim passages	28
Total deadweight carried over loaded-ship passages	212,424 tons
Total deadweight carried over ballast-trim passages	53,853 ,,
Average displacement of loaded-ship passages	10,160 ,,
Average displacement of ballast-trim passages	4,995 ,,
Average speed per hour over complete steaming period	10·01 knots
Best average speed, loaded-ship passage ..	10·57 ,,
Best average speed, ballast-trim passage	13·94 ,,
Average coal consumption per day, round voyage, steaming at sea, all purposes —including steering, lighting, pumping, heating and cooking	24·68 tons
Average pounds of coal per I.H.P. per hour steaming at sea	1·28 lb.
Average round-voyage coal coefficient, $\frac{D^{\frac{2}{3}} \times V^3}{\text{Tons coal per day}}$	16,820
Coal coefficient for best fine-weather loaded voyage	22,100
Coal coefficient for best fine-weather ballast voyage	31,500

During the whole of the period under review the pulverising and coal-burning outfit worked most satisfactorily, and no stoppage or delay to the ship was experienced. The linings of the pulverising chambers have not been disturbed since first installed, while the beaters have been changed twice only. The question of the freeing of the smoke-boxes, &c., from the fine-ash deposits has now been dealt with by a water-jet suction plant, which method does away with the dust and dirt experienced with the ash-bucket system. Three firemen only are carried in the ship, against nine men in a similar-sized, hand-fired, coal-burning vessel. It may be noted that 1884 tons of ballast water is carried on light voyages. This ballast is discharged at sea when approaching a loading port; consequently, the coal used is reckoned in the steaming consumption.

In the opinion of the owners, it may be justly claimed that the performance of this ship, a pioneer effort, has been marked with success. Conversion jobs naturally present difficulties, owing to stokehold space, the disposition of bunkers, and the design of boiler uptakes and air heaters; but, in the light of the experience now gained, no difficulties should be presented in new tonnage.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Few Encouraging Signs.

INDUSTRY in the Midlands and Staffordshire is at a low ebb, and this has naturally a depressing effect upon the iron and steel market. Demand for materials for the various industries in the area is inert, the barest minimum of material being purchased at a time. There are few signs to encourage hope of a spring revival in trade. Even those few optimists who foresee an improvement admit that the encouraging signs in the outlook are not impressive if set against the widespread adversity. The weekly gathering of iron and steel masters and material users on 'Change in Birmingham to-day—Thursday—brought no fresh stimulus to any department. Prices are wavering where free competition exists, but are generally maintained in those branches where there is concerted action among sellers. The ironmasters' quarterly meeting will be held on Thursday, April 16th. As a rule, this is held on the second Thursday of the new quarter, but as this falls in Easter week the meeting has been deferred.

Steel.

Buying of steel on the Midland market is at a minimum. The structural engineers have a few orders to execute, but they are not making any demands upon the resources of the steel works. The engineering and shipbuilding trades continue very quiet, and until they show active signs of life there can be no improvement in the heavy steel mills. Special steels for the automobile industry are in growing request, but orders, though more regular, remain of small extent. Rolling stock establishments here are not calling for anything like their normal supplies, while producers of Midland manufactured goods are on the whole so poorly employed that they have little recourse to the material market. As a consequence of this general depression in the consuming industries, district steel works are poorly employed. They are working for the most part on a day-to-day basis, having practically no orders on their books. Heavy steel prices are maintained at the Association level. Angles are £8 7s. 6d., tees £9 7s. 6d., joists £8 15s., and ship, bridge and tank plates £8 17s. 6d., less their respective rebates to those who confine their purchases to British material. There has been some weakening of the position in the boiler plate department. Demand is so slack that producers have been unable firmly to uphold the recent price of £9 5s. per ton. Though this figure is still generally quoted, it is reported that half a crown less has been accepted, and inquiries lead one to believe that if business were offered it would not be refused in some quarters, at least, at £9 2s. 6d. per ton. Purchases are no brisker in the half-products branch of the steel trade where competition for the available business is extremely keen. District re-rollers quote small bars rolled from foreign billets at £7 2s. 6d., upwards, but they fail to find many purchasers. All-British bars are unchanged in price. Mild steel billets make £5 5s. per ton upwards. Birmingham importing merchants and agents are scouring the market for inquiries amongst customers who usually take continental steel. For 2in. billets French and German houses would take £4 5s. delivered, and small steel bars could be had at £4 17s. 6d. upwards. Even at these prices there are few buyers. The fact is that the material is not required for immediate making up, and manufacturers refuse to buy for stock.

Raw Iron.

The market for pig iron is as restricted as ever. Few contracts are being entered into, consumers preferring, as a rule, to buy in small tonnages of just sufficient volume to cover their immediate requirements. Efforts to persuade ironfounders to increase their specifications are unavailing. Most of the foundries in this district are short of work, and the requirements of engineering, jobbing and light foundries are easily met. Stocks at furnaces are large, but there is hardly any surplus material in the hands of consumers. Derbyshire smelters affiliated with pipe foundries continue to find an output for practically all their production. Cast iron pipes are just now in active demand, and makers are using considerable tonnages of pig iron. Northamptonshire and North Staffordshire furnacemen are not so well placed, and although the former are disposing of a quantity of iron outside this district, they are still unable to sell the whole of their production. Foundrymen and forgemen continue to press for better terms, but there seems little likelihood of any fall in selling prices in the immediate future. Previous concessions by Midland blast-furnacemen have not stimulated the demand, and, in addition, smelters have a very good reason for not reducing the price in that present production costs are barely covered. On 'Change in Birmingham to-day raw iron was quoted firmly on the basis laid down by the Central Pig Iron Producers' Association, namely, Northamptonshire: Forge, £3 2s. 6d.; No. 1 foundry, £3 10s. 6d.; No. 2, £3 9s. 6d.; No. 3, £3 7s. 6d.; No. 4, £3 6s. 6d. Derbyshire: Forge, £3 6s.; No. 1 foundry, £3 14s.; No. 2, £3 13s.; No. 3, £3 11s.; No. 4, £3 10s.—all per ton delivered at stations in the Black Country and subject to rebate.

Manufactured Iron.

There is no indication of the coming of the usual spring demand in the Staffordshire finished iron trade. Business is decidedly bad, and most, if not all, of the works are on short time. Orders come in in driblets, and ironmasters cannot see any time ahead. The position is made worse than it would have been some years ago by the fact that ironmasters have now to compete against steel for the engineering trades, especially now that rust-resisting steel is being widely used for purposes where finished iron was formerly preferred, owing to its resistance to corrosion. The makers of best grade bars are now definitely feeling the effects of the shortage of orders, and although their plight is not so bad as that of producers of Crown and common bars, it is serious enough. Selling prices of marked bars remain steady at £12 10s. per ton. They are likely to continue so as they depend upon the cost of raw material. Staffordshire makers of Crown bars complain of undersselling by other districts. Supplies can be obtained, it is stated, at £9 12s. 6d., but quotations on this market rise from £9 15s. to £10 and upwards, according to the reputation of the mill for quality. Little of this material is changing hands. Nut and bolt and fencing bars are practically unsaleable at £8 15s. per ton. No. 3 Belgian iron is offered at £4 17s. 6d., representing a difference of nearly £4 as compared with Staffordshire common bars. The superior quality of local iron is claimed to be insufficient to justify its purchase at the price. Wrought iron gas tube strip is not such a good market as it was. Makers have, however, some reserves of orders, and are able to maintain selling prices at £10 17s. 6d. per ton. There are some mills which demand fully half a crown above this figure for their production.

Galvanised Sheets.

It would appear evident from the fact that makers of galvanised sheets at their monthly meeting last week reaffirmed prices on the basis of £11 for No. 24 gauge, that they are satisfied in their own minds that the market is not to be stimulated by price reductions. Consumptive demand is at a low ebb, and district mills have considerable difficulty in making up rolling programmes. Output is of a very restricted character. Stocks in some quarters are large, and it is possible to get deliveries of ordinary sizes at very short notice, hence users see no necessity to place bulk orders. Black sheets are in moderate request at recent selling rates.

Rolling Stock.

Makers of rolling stock in the Midlands are looking anxiously into the future for some reinforcement of demand which will avert a further decline of activity. The works have been very short of contracts recently, but the receipt of a few orders from the home railways, mainly in connection with electrification developments, has strengthened the position a little on the carriage side. There is no sign of any increase in the demand for wagons, the railways being already overstocked, and, further, there is little likelihood of an early revival in the demand. Private traders, it is asserted, will have no need to sink more capital in wagons for a long time to come. Fortunately, the outlook abroad, which at the present moment is unpromising enough, is expected to improve in the near future.

Machine Tools for Russia.

The Coventry machine tool firm of Alfred Herbert, Ltd., has entered into an arrangement with Arcos, Ltd., for the supply of £100,000 worth of machine tools for Russia. The orders will be placed within nine months. Alfred Herbert, Ltd., have done business with Arcos, Ltd., for many years, and the present order comes at a very opportune time. It ensures that the firm will be able to retain the present complement of employees at the Edgwick Works, Coventry, for some time to come, but the stimulus is not sufficiently large to necessitate the engaging of additional hands.

Expanding Demand for Motor Cars.

The Midland automobile industry, though continuing patchy, shows improvement. Car makers have been better employed in the last few weeks, both for the moderately priced models and those which can command a higher price. The advent of fine weather and the holiday season has given a much-needed filip to the home trade. Orders for overseas are also being received, but conditions existing in Australia have administered a check upon a market in which various local firms were doing an improving trade. Elsewhere, however, progress is being made. Automobile engineering firms specialing in omnibuses, motor coaches, and commercial vehicles, report business as fairly good, though not up to last year's standard.

Cannock Coalfield New Terms.

In the Cannock Chase coalfield a wages settlement to operate after the end of the existing temporary agreement, which terminates on the 31st inst., has this week been achieved. As the result of conferences between the owners and the miners, new terms, which are to last for three months, *i.e.*, April, May, and June, have been agreed upon. Wages are to be paid at the rate of 40 per cent. on the prevailing wage basis, compared with the present 42 per cent., and there is to be an additional payment of 5 per cent. to all contract or piece-workers. These rates will be for a 7½-hour day, instead of an 8-hour day now being worked.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Steel Corporation's First Year.

MORE than usual interest attaches to the annual reports of the Lancashire Steel Corporation and the Wigan Coal Corporation for the twelve months to the end of December last, for the period represents the first year's operations of both organisations. The actual formation was not completed until August of last year, but the businesses of the Partington Steel and Iron Company, the Wigan Coal and Iron Company, the Pearson and Knowles Coal and Iron Company, the Wigan Junction Colliery Company and the Moss Hall Coal Company—the vendor companies—was carried on on account of the two corporations as from the beginning of 1930. Before providing for depreciation, consideration of which has been deferred until further progress has been made with the development scheme, the Steel Corporation's gross profits amount to £47,938, and the sum of £3913 is left to be carried forward after making provision for a stock reserve—£16,000—directors' fees, interest and income tax, with £15,653 allocated to the reduction of the preliminary expenses account. A significant point in the directors' report is that the blast-furnaces and steel works at Wigan have been closed down and that the property is now being dismantled. The gross profits of the Wigan Coal Corporation, before making various allowances, were £30,809, and finally the sum of £436 has been carried forward. In neither instance have dividends been declared.

That Sullen Feeling.

It is the experience of Mr. H. C. D. Scott, of Royles, Ltd., engineers, Irlam, near Manchester, that schemes of profit-sharing in engineering concerns can do much to remove the dissatisfaction—Mr. Scott described it as "sullenness"—about which so much is heard in the industry. Messrs. Royles, who employ rather more than 300 people, have had such a scheme in operation during the last eleven years, and he directly attributes to it better time-keeping by the men, savings in stores and materials, quicker execution of emergency jobs, and a diminution of "slacking." The sum of £35,968 has been distributed among the firm's employees since the scheme was inaugurated. Mr. Scott blames the existence of so many "absentee" directors in the engineering industry for much of the trouble that is experienced.

Working Conditions in the "Shops."

A resolution voicing opposition to the employers' proposals regarding wages and working conditions, similar in terms to that noted in this column a week ago in respect of the Manchester district, has been passed at a meeting of branch officials and shop stewards called by the Oldham and District Engineering and Allied Trades Joint Committee.

Boiler Examinations.

The total number of boiler examinations carried out under the auspices of the Manchester Steam Users' Association last year was 22,283, the membership of the Association now amounting to 1502. The annual report states that Mr. V. B. Harley-Mason was appointed to succeed the late Dr. Telford Petrie as general manager and engineer-in-chief, with Mr. E. G. Ritchie as chief engineer of the boiler inspection department.

Dividend Passed.

The directors of John Hetherington and Sons, Ltd., textile machinists and tool makers, Manchester, announce that the dividend on the 7 per cent. preference shares due at the end of March will not be paid, making the distribution in arrear to the extent of eighteen months.

Non-ferrous Metals.

A general setback has been experienced on the non-ferrous metals market during the past week, though tin has been less seriously affected relatively than the others. Whatever may eventually be the outcome of the tin restriction scheme, the statistical position at the moment seems to be not too promising. As already mentioned, reports as to consumption in American tin-plate mills have lately been more encouraging, but so far this has not been sufficient to exert any material influence on the general situation. Support from the Welsh industry is on much the same unsatisfactory lines as before, and prices compared with a week ago have given way to the extent of from 25s. to 35s. a ton, according to position, current values being lower than since the middle of last month. Buying interest in copper during the past week has been speculative rather than industrial, and the relatively poor general demand has served to wipe out the whole of the ground gained since early in February, standard brands of the metal at the moment of writing being roughly 16s. below last week's parities. Weakness has been more pronounced in lead than in any other section, heavy supplies in relation to the demand forcing down quotations on balance by nearly 30s., a decline of 12s. 6d. to 15s. in spelter on the week being directly attributable to the same causes.

Iron and Steel.

Some slight improvement has been in evidence in certain branches of the Lancashire foundry trade, with textile machinery makers the outstanding exception. After the slight spurt witnessed during the past few weeks, a buying lull has again developed on the foundry iron market here, but, in view of the fact that the majority of consumers have covered themselves for the time being, this was not altogether unexpected. So far as Midland pig iron is concerned, quotations are held at 69s. 6d. per ton, delivered in the Manchester area, for Staffordshire and Derbyshire makes, and 68s. for Northamptonshire. Offers of North-East Coast foundry irons, however, are now generally on the same price basis as Midland brands for delivery in Lancashire, but it is doubtful if the former, having regard to the length of time they have been absent from this market, have so far met with much success. Scottish iron is a shade easier at about 89s. 6d. per ton, delivered equal to Manchester, with West Coast hematite unchanged on the week at about 82s. 6d. Constructional engineers in the district are no better situated than before, although there is some hope of more bridge work being released in the near future. Meanwhile, specifications from this and most other directions are for small quantities for virtually prompt delivery, with forward contracts conspicuously absent. Small re-rolled bars are

cheaper at from £6 15s. to £7 per ton, but in other sections of the steel market prices have been maintained at last week's levels.

BARROW-IN-FURNESS.

Hematite.

The small improvement in the demand for hematite pig iron is, generally speaking, maintained. The two steel departments at Workington and Barrow respectively have, for some weeks, been taking a fair tonnage of iron, and this naturally has kept up the demand, and, in places, allowed of a slight reduction of stocks, which were too high for comfort. The outlook in the steel trade is not good, and if fresh orders do not come to hand very soon, there is a likelihood of some of the mills stopping. This would mean that more iron would be available for the market, and as the market is not ready to absorb it, it either means stocks swelling or furnaces being damped down. Foreign trade in pig iron is quiet. There was a cargo from Barrow to Antwerp last week. Iron ore is quiet and likely to be, as neither the local nor the outside demand shows any sign of improvement. Steel is dull and orders are scarce.

SHEFFIELD.

(From our own Correspondent.)

No General Improvement.

THE principal branches of the steel industry in this district display no sign of general revival; in fact, some reports show a continued shrinkage of sales and output. In the open-hearth steel section, the depression becomes more acute. Hardly a third of the furnaces are at work; and the output is considerably below that of any time last year. Makers are finding it difficult to dispose of even this restricted production, and the inquiries coming to hand do not hold out any hope of improvement. The market for basic scrap is weaker, consequent upon the suspension of deliveries at one of the largest consuming works. There is still a better report from special lines than from ordinary commercial steels. Corrosion-resisting alloys are in good demand, and a large volume of products is being turned out for the motor car building trade. Cold-rolled steel and strip is fairly active. Engineers in the home market are sending in a steady flow of orders for the best tool steels, but the quantities are not large. There is also a regular home trade in hand and engineers' small tools. In both these branches, however, the overseas demand is severely restricted. It is confidently expected, though, that certain British colonies will be increasing their purchases before long.

Company Reports.

The trade in railway supplies is still on a meagre scale. John Baker and Bessemer, Ltd., of Rotherham, who are principally engaged in this trade, are able to report that they did better in 1930 than in 1929, their profit amounting to £24,227, as compared with £19,121. The directors state that, notwithstanding the acute depression in the coal and iron industry, the output for the year was at a high level, one department of the works being fully employed for most of the year. This was due mainly to the extra work following the acquisition of Henry Bessemer and Co., Ltd., other measures also contributing. In general, selling prices were lower, and this, to some extent, offset the benefit of increased output. They add that the latter part of the year saw a rapid decline in the demand for railway materials, and, unfortunately, this continues. The dividend of 4 per cent. is repeated. Vickers, Ltd., have also issued their report during the week. This shows a falling off in net profit, the amount being £775,925, as against £941,971. They are again paying a dividend of 8 per cent. The report does not review the state of the company's trade during the year, but in the balance sheet of Vickers-Armstrongs, Ltd., there is a reference to the trading loss of the English Steel Corporation. Cammell, Laird and Co., whose increased profits have previously been referred to, state that these were derived from the shipyard, income from investments showing a falling off.

Government Orders.

The latest list of Government contracts shows that work has been placed with a good number of firms in this district. The Crown Agents for the Colonies are taking tires from Samuel Fox and Co., Ltd., and the English Steel Corporation, Ltd.; pipes from the Stanton Ironworks Company, Ltd., and the Staveley Coal and Iron Company, Ltd. The Admiralty has ordered steel plates and other goods from the Park Gate Iron and Steel Company, Ltd.; steel rods, discs, sheets and bars from Hadfields, Ltd., Andrews Toledo, Ltd., Swift, Levick and Sons, Ltd., J. Beardshaw and Son, and the Rotherham Forge and Rolling Mills Company; horse-shoes from William Cooke and Co., Ltd.; cramps, clamps and vices from Charles Neil and Co., Ltd., Easterbrook, Allcard and Co., Ltd., C. and J. Hampton, Ltd.; firehearth gear from Moorwoods, Ltd., and W. Green and Co. (Ecclesfield), Ltd. The Air Ministry has placed a contract for bomb boxes with the Sheepbridge Coal and Iron Company, Ltd., and one for cable with John Shaw, Ltd., Sheffield. The United Strip and Bar Mills, Ltd., is to supply steel work to H.M. Office of Works.

For Russia.

Among the contracts recently placed with British firms by the Soviet Trade Delegation is one with the Metropolitan-Vickers Electrical Company, Ltd., amounting to more than £200,000, for the supply of electrical equipment for blooming and rail mills.

The Electric Furnace.

Electric Furnace Company, Ltd., of London, have just booked orders from Sheffield firms for two of their Ajax-Northrup high-frequency electric crucible furnaces. These will bring the number of such furnaces installed in Sheffield, or on order, to ten, or probably twelve. The more recent ones are of larger capacity than the early furnaces. A French firm has installed one of 28 cwt. capacity, besides four of smaller size.

Sheffield and Dagenham.

On the occasion of a visit of Sheffield and district motor dealers to the new Ford works at Dagenham, Essex, last week, it was stated that 13,500 tons of Sheffield steel work had been used in the construction of the walls and roofs. An agent of the firm added that until the plant was working at full capacity the large amount of forgings and stampings needed would be produced in Sheffield, and also that Sheffield would always supply the raw material.

Two Expert Views.

The Sheffield Chamber of Commerce, in its annual report, states that "Sheffield still leads the world in all the higher and finer classes of steel. New uses for steel have been found, and there is no doubt that civilisation is slowly entering upon a steel age in which Sheffield and its heavy steel industries will be able to participate to the fullest extent." Sir Arthur Balfour, the head of the recent Trade Mission to Egypt, in an address to the Chamber, on prospects in that country, said the Sheffield steel trade was already catered for almost too well, and there were only one or two repair shops able to buy Sheffield steel in any quantity, outside of the Suez Canal and railways. With regard to Sheffield tools and cutlery, he said that undoubtedly there is a big business to be done with the fellahin, but it is of a very cheap order.

Cutlery and Plate.

These trades continue in a very unsatisfactory state, so far as the home demand through ordinary shop-keeping channels is concerned. The output of stainless table knives is considerably below the normal. Trade in best pen and pocket cutlery keeps steady, but is not of very large volume. There is also a well-sustained demand for cabinets of cutlery for presentation purposes, but here again, the trade is not large in the aggregate. One of the most satisfactory features is still the call for table outfits for hotels and restaurants, which brings a good deal of work to several firms. There are also some large special orders on hand for articles to be distributed in return for coupons. At the annual meeting of Mapping and Webb, Ltd., the chairman reported that the Sheffield factory had not done badly. "Princes Plate" was still going strong, and there were considerable orders in hand both for hotels and railways. Government contracts for electro-plated articles have been placed with Mappin and Webb, Ltd., Walker and Hall, Ltd., Gladwin, Ltd., and Viners, Ltd., all of Sheffield.

Sheffield's New Reservoirs.

As readers of these notes are aware, Sheffield Corporation has had a good deal of trouble in connection with the reservoirs of its great Ewden Valley water scheme, on which about a million and a half has been spent. Serious geological defects have been encountered, which have necessitated the carrying out of much remedial work, and more has yet to be done. A few months ago, however, three eminent engineers reported that the cementation and other works already executed were sufficient to permit water to be impounded and use to be made of the reservoirs, and that they were prepared to sign a certificate that the public would not be endangered by such impounding. It is now announced, that these certificates have been issued, showing that the More Hall Reservoir can be properly filled with water up to a level not higher than 5ft. below the overflow level, and the Broomhead reservoir to a height not more than 15ft. below the overflow level. These are preliminary certificates, which, it is understood, will be followed by the issue of final certificates when the reservoirs have been examined after the impounding of water. In their recent report, already referred to, the engineers expressed the opinion that the further remedial works might take two years to complete, at a cost probably not exceeding £100,000.

NORTH OF ENGLAND.

(From our own Correspondent.)

New Rolling Mill.

IN view of the extension of business, Darlington Rolling Mills Company, Ltd., has decided to build another rolling mill at Rise Carr, Darlington. The firm is controlled jointly by Dorman, Long and Co., Ltd.—through amalgamation with Bolckow, Vaughan and Co.—and the Crittall Manufacturing Company, Ltd., and some eighteen months ago a special mill was laid down for the accurate rolling of light steel sections. Prior to the establishment of this plant no mill in this country could work to the fine limits demanded by Messrs. Crittall's for the manufacture of metal window frames, casements, and the like. Material previously imported from the Continent is now being rolled at Darlington, and a new industry has been firmly established. The new rolling mill building will be of similar construction to that built eighteen months ago, having a steel frame with brick panelling. It will be 250ft. in length and 82ft. in width. About 400 workmen are employed by the firm at present, and it is expected that when the new mill is completed and production starts, in about nine months' time, another eighty or ninety men will be employed.

Reconstructed Oil Tanker.

Another ingenious ship reconstruction project was brought to a successful conclusion by Palmer's Shipbuilding Company, Ltd., Jarrow and Hebburn, this week, when they put through highly satisfactory sea trials the oil tanker "Saranac," which they have made into practically a new vessel by incorporating a new centre section. This method of dealing with an oil-carrying vessel is an innovation, and is an idea of the Anglo-American Oil Company, Ltd., the owners of the "Saranac," to prolong the life of an oil tanker which is seriously affected by the corrosive qualities of various oils. The operation of building a new tank or centre section into a vessel of this type was successfully carried out by Palmers' Company last year on the "Cadillac," a sister ship of the "Saranac," and has caused a considerable amount of interest in shipowning circles. The "Saranac," which was built by Parsons in 1918, is a vessel over 400ft. in length and of about 17,000 tons deadweight, and the new centre portion, which was built by Palmer's Company, was about 350ft. in length, and was practically the hull of a new ship. The "Saranac" was docked at Hebburn and cut into three parts, and the new section built in, the whole operation requiring great skill and careful handling. The work was completed in about nine weeks.

Cleveland Iron Trade.

While the volume of business is still restricted in the Cleveland pig iron trade, particularly for export, and in the Scottish market, a hopeful feeling has been created by a slight increase of activity in the steel trade and the circulation of inquiries for pig iron supplies for the second quarter of the year. Some consumers are still adopting a very cautious attitude, and only place orders to cover their immediate needs. Ironmasters, however, hold out no hope of lower quotations. No. 1 Cleveland foundry iron is 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

East Coast hematite pig iron values show a further downward tendency. Though there are makers who hold out for more than the equivalent of ordinary qualities at 67s. 6d., customers claim they can readily satisfy their requirements on that basis and report that they have bought at a little less. Small odd sales to the Continent continue, but most of the limited business passing is for home use.

Ironmaking Materials.

Consumers of foreign ore are off the market, and the nominal price of best Rubio remains at 16s. c.i.f. Tees. There is no show of renewed activity in the iron trade to give a better tone to blast-furnace coke. Sellers offer good medium kinds at 16s. delivered at the works, but ironmasters are not disposed to pay that figure.

Manufactured Iron and Steel.

There is no special feature in the manufactured iron and steel trade. Distribution of specifications for shipbuilding requisites are on a very unsatisfactory scale, but some of the steel plants are more regularly employed on railway and constructional steel. Prices are unchanged.

The Coal Trade.

The Northern coal market maintains a very good tone up to Easter. Supplies for the next three weeks are very scarce and quoted firm. For early April moderate quantities of steam coals are on offer at about firm prices. After Easter, however, merchants are not testing the market to any extent, and in most cases overseas consumers seem to content themselves with sounding the position and marking time in hopes of lower prices. Best Northumberland steams are offered according to individual positions at from 13s. 9d. to 14s., with Tyne primes quoted steadily at 12s. 9d. There is no improvement in steam small coal values. Stocks continue to increase. Best qualities remain at 10s., and ordinary at 9s. 6d. Heavy bookings, and a well-sustained demand for first grade bunker coals, both for ships' use locally and for the coaling stations, maintain prices at a firm level of 15s. for best qualities. Second sorts, however, are more plentiful, but are holding steady at 13s. 6d. Up to the middle of April, all gas coal is quoted fully steady. For later positions, however, buyers are holding off, and the undertone is rather easier. Best qualities are 14s. 9d. to 15s., secondary 13s. 6d., and special gas sorts 15s. 3d. to 15s. 6d. Durham coking unscreened are in very slow demand, and in ample supply at 13s. 3d. The coke trade is irregular. Gas coke is moving rather quietly, and while the prompt position rules firm, the forward outlook is disappointing. Best kinds are unchanged at 21s. Patent oven coke stocks are steadily increasing, and values weakly indicated at 16s. Beehive and special foundry coke is a quiet trade at 22s. to 26s.

SCOTLAND.

(From our own Correspondent.)

Conditions Unchanged.

THOUGH in certain directions the outlook may be just a shade better, owing to a little more freedom in the placing of export orders, conditions are not much better, as the total volume of business represented is still comparatively small. Producers are a shade more hopeful that the movement may expand, but at the moment the position generally remains most unsatisfactory.

Steel.

Steel makers' reports indicate a continued scarcity in specifications for plates and sections, the aggregate turnover being altogether inadequate to provide employment for the plants. At present there is a fair demand for structural steel. Business in light black sheets has improved a shade, but galvanised descriptions are still very quiet. The demand for tubes is depressed, especially in respect to small diameter descriptions. Though overseas demands are still very limited, steel producers are of the opinion that stocks abroad must be greatly diminished, and that buying on more extensive lines cannot be long delayed. Prices are unchanged.

Iron.

There is still very little movement in bar iron, but re-rolled steel has been a shade more active of late. Bar iron is unchanged in price, but re-rolled steel bars are somewhat easier at £6 10s. home and £6 7s. per ton export.

Pig Iron.

Pig iron is depressed, and without change in values. Importations of material from India and the Continent react against the home producer, and the seven furnaces remaining in action are more than equal to the demand. Shipments of pig iron from Glasgow last week amounted to 682 tons—635 tons foreign—compared with 575 tons—535 tons foreign—in the same week last year. During last week some 600 tons of pig iron from Barrow were unloaded at Bowling.

Scrap.

The market for scrap remains easy, with cast iron machinery at 55s. and heavy steel 47s. 6d. per ton.

Coal.

In some districts, and more particularly in the east of Scotland, the restriction of outputs under the quota system is causing a shortage of supplies in certain qualities of fuel for shipment. Best qualities of household coal too are affected. Foreign demands have not improved to any extent, shippers not being in a position to quote prices likely to attract overseas buyers, but with the shortage already referred to the prices of certain sorts are firmly maintained. Treble and double nuts are strong in all districts. Smaller sizes are weak, however. Aggregate shipments amounted to 227,095 tons, against 180,858 tons in the preceding week and 239,629 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

EXTREMELY quiet conditions are the feature of the steam coal export trade of this district. There has been no improvement in the current demand during the past week, and most people concerned with the trade fail at the moment to see where the expansion so much longed for is to come from. There are so many conditions abroad conspiring to adversely affect the volume of inquiry. Stocks of coal on the Continent are so excessive, and particularly so far as France is concerned; municipalities and general utility undertakings are being pressed to consume native coal. World-wide depression is contributing to under consumption of coals, and, furthermore, financial conditions in a number of directions are not favourable to an increase of coal orders. Yet shipments of Welsh coals maintain a fair level, though this level is much below what is desired or is necessary to keep collieries which are working fully engaged. According to the Great Western Railway Company's returns, shipments last week came to 463,700 tons, which compared with 479,800 tons for the preceding week, but the comparison with the corresponding period of last year does not afford satisfaction, as the total then was 567,278 tons, which shows a diminution of just over 100,000 tons. Collieries were enabled to make a fair start this week, as although at the end of last week the number of idle tipping appliances was thirty-three, tonnage arrived up over the week-end in sufficient volume to permit of more active shipment conditions, as on Monday the number of idle tipping appliances was reduced to seven, and there were three steamers waiting to berth. Still, the volume of chartering operations does not inspire one with the belief that really busy conditions can prevail for long, or that there will be anything like pronounced loading pressure immediately before the holidays. Not only is the current inquiry for coals quiet, but there is not much demand on contract lines. The French Marine has asked for prices for about 30,000 tons of steam coals, and Spanish Sugar Works are in the market for about 20,000 tons of sized coals, for which there will undoubtedly be keen competition.

Coal Strike Averted.

Grave fears were entertained practically all last week that very serious trouble might develop in this coalfield as a protest against the award of the independent chairman. As mentioned last week, the miners at several collieries took it into their own hands to stop work, but fortunately before the end of the week all decided to resume work and await the decision of the adjourned conference of coalfield delegates. This conference was called for Saturday instead of Monday last as originally arranged, and there was considerable relief when it became known that the recommendation of the leaders was accepted, and that there was to be no stoppage. It was, however, a very near thing. On a card vote the Executive's recommendation was carried by 787 to 747, and as each card represented 50 members, there was therefore a majority of 2000. The number of delegates attending the conference was 227. In addition to the Executive's recommendation there were two propositions before the conference, these being a down-tools policy to be adopted at once, and a fortnight's notice to terminate contracts. The Executive's recommendations were that the M.F.G.B. should be asked to call a special national conference, to which the forty-two miners' Members of Parliament should be invited, for the purpose of considering the low wages paid in the British coalfields, and to decide what amendments are required in the Minimum Wage (Coal Mines) Act, 1912, to secure that the minimum rates of wages to be paid in the industry shall be at least equal to the 1914 rates with the cost of living added; the establishment of the principle of a weekly minimum wage; and the extension of the Act to workmen employed on the surface of the collieries. Further that, pending the new legislation indicated, the Executive Council be instructed to give the necessary notice to apply for a revision of the present minimum standard rates under the provision of the present inadequate Minimum Wage Act; the workmen of this coalfield to continue working until the result of their efforts in this direction is known.

South Wales Coalowners.

At the annual meeting of the Monmouthshire and South Wales Coalowners' Association held at Cardiff on Monday, Mr. W. D. Wight, one of the leading engineers in this district was unanimously elected Chairman for the ensuing year, and Mr. G. D. Budge, managing director of the Cardiff Collieries Company, Ltd., was elected Vice-chairman. Mr. Wight has twice been President of the South Wales Institute of Engineers, while Mr. Budge is the present President of this Institute. It was reported that the output of the members in the three District Boards, viz., Cardiff, Newport, and Swansea, for the year ended December 31st last, was 43,170,316 tons, which compared with 45,660,271 tons for the preceding year, so that there was a reduction of 2,502,196 tons. The assurances of the members for the year ending March, 1931, and for the year ending March, 1932, were as follow:—1930–31, 47,832,129 tons; 1931–32, 43,051,814 tons—a reduction of 4,780,315 tons.

Miners' and Trimmers' Holidays.

It has been agreed that the Easter holidays in this coalfield shall be Easter Monday, Tuesday, and Wednesday. As regards work at the docks, the coal trimmers will work two shorts on Thursday, April 2nd. There will be no work on Easter Monday and Tuesday, but two short shifts will be operated on the following Wednesday, with work as usual on the Thursday.

Current Business.

The tone of the steam coal market rules quiet in all departments, and there has certainly been no improvement in the prices obtainable. These remain at the minima. As regards small coals, which have been so excessive for some time past, there was a meeting last week of the Executive Council of the Marketing Association when consideration was given to the question of reducing minimum prices for these qualities. The Council decided, however, that there should be no variation, as it was in the interests of the industry that no revision should take place. This decision effectually disposes of the reports that it was intended to make changes with a view of assisting collieries to reduce their heavy stocks of smalls. The demand for patent fuel remains quiet, and there is no improvement in the inquiry for coke. Pitwood is a shade steadier, reduced supplies of this commodity being brought forward.

Canadian Engineering News.

Smelter Expansion Planned.

Providing prompt deliveries of materials can be arranged, the directors of Falconbridge Nickel Mines, Ltd., propose to utilise a period of temporary suspension of production to make necessary extensions to the blast-furnace at the Falconbridge property, preparatory to placing the mine on a basis of approximately 450 tons of ore per day when additional electric power is made available.

Astronomical Observatory.

An astronomical observatory housing a large reflecting telescope 74in. in diameter will be erected near Toronto in the near future. The observatory, which will be known as the "David Dunlap Observatory," will be erected by Mrs. D. A. Dunlap and her son, D. Moffatt Dunlap, as a memorial to the late David A. Dunlap. A tentative site has been chosen and the order for the telescope has been awarded to the firm of Grubb, Parsons and Co., Newcastle-on-Tyne. It will be about three years in the making.

Radio Static Research.

Extensive experiments, directed by Professor J. G. McLennan, head of the Physics Department of the University of Toronto, and aiming at the discovery of an entirely new medium of radio transmission, have been going on quietly for some time now along the Temiskaming and Northern Ontario Railway, north of Cochrane, and will, with the co-operation of the Mines Department of the Ontario Government, be pushed further during the winter months. Elaborate instruments have been arranged at Blacksmith Rapids, centre of the Government's new lignite coalfields, and assistants to Dr. McLennan are engaged at the present time in photographing the northern lights in an effort to learn if they cause static disturbances—the plague of radio reception. Blacksmith Rapids has been selected as a base for experimental operations because of the particularly clear atmosphere to be found there.

130 lb. Rails.

The steel plant of the Dominion Coal and Steel Company at Sydney, Nova Scotia, is now rolling the heaviest rail ever made in Canada. The new rail weighs 130 lb. to the yard. It was only a short time ago that 100 lb. rail was considered heavy, but with the increasing size of locomotives and heavier rolling stock it has been found necessary to increase the weight of rails.

Mineral Exploration.

During the past season exploration for minerals and investigations of discoveries in the North-West Territories were continued actively. The results may be summarised as reasonably successful. Discoveries have been chiefly of base metals—copper, lead-zinc, and nickel—but in the mineralised areas too little work has yet been done to determine their possibilities. The occurrence of cobalt and uranium at the south-easterly side of Great Bear Lake, is somewhat similar to the cobalt area of Northern Ontario, and suggests silver possibilities. The apparently extensive copper deposits of the Coppermine area resemble the Michigan deposits in mode of occurrence and geological situation, and point to this district as one of the big copper reserves of the future, while the development work of the season has demonstrated new possibilities in the lead-zinc deposits of Great Slave Lake. The chief northern field of interest was in the country between Great Bear Lake and the Arctic Coast. A rich discovery of copper sulphides was staked in 1929 at the easterly extremity of McTavish Bay.

CONTRACTS.

STEATITE AND PORCELAIN PRODUCTS, Ltd., asks us to state that they have received the order for insulator strings for use at railway crossings on the Punjab Uhl River hydro-electric scheme.

SIR WILLIAM ARROL AND CO., Ltd., has received an order from the London and North-Eastern Railway Company for four coaling appliances at Harbour-terrace Coal Staith, West Hartlepool.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has received repeat orders from the London Underground Electric Railway Company for the following mercury are rectifiers:—Seventeen of 1500 kW each and five of 2000 kW each; over 100 air blast transformers; 120 high-speed circuit breakers and sixty heavy duty oil circuit breakers. The company also has in hand the manufacture of two 1200-kW mercury arc rectifiers for the London, Midland and Scottish Railway Company Barking and Upminster electrification scheme.

WHITWORTH SOCIETY.—The eighth annual Commemoration Dinner was held on Monday, March 23rd, at the Holborn Restaurant, with the President, Sir Henry Fowler, in the chair. He announced that Professor F. C. Lea, of Sheffield University, had kindly accepted nomination as President-elect, to take office in July next, and that the Summer Meeting of the Society would be held in Sheffield upon a date to be subsequently announced.

SPANISH.—In view of the interest aroused by the Buenos Aires Exhibition and the impetus which it is likely to give to British trade in S. America, our readers may be glad to know that there is an Anglo-Spanish and Spanish-American Institute of London, of which the Prince of Wales is President, and the headquarters at the City of London College, Ropemaker-street. It gives voluntary assistance to students and visitors from Spanish and Portuguese-speaking countries and keeps in touch with educational centres at which suitable language courses are arranged. In Cardiff, for example, over one hundred students are taking the Spanish course at the Technical College, and Portuguese classes are being arranged. It is the desire of the Institute to see branches opened in other centres.

COOPERS HILL WAR MEMORIAL PRIZE AND MEDAL.—A prize, which was founded by members of the Royal Indian Engineering College, Coopers Hill, in commemoration of members of the College who fell during the war, is awarded annually by the Institution of Civil Engineers and triennially in turn by the Institution of Electrical Engineers, the School of Military Engineering, Chatham, and the School of Forestry, Oxford. It consists of a bronze medal, a Parchment Certificate of Award, and a money prize to the value of about £25, and this year the Council of the Institution of Electrical Engineers has to make the award. The best paper on a professional subject must reach the Secretary of the Institution not later than October 1st next. The subjects that have been selected for the competition are: "The Use of Electricity in Public Works," "Hydro-electric Power Developments," "Electrification of Railways," "Electricity in Agriculture," "Electricity in Mines," "Long Distance Telephony (excluding Wireless)," "Long Distance Telegraphy (excluding Wireless)," "Overhead Lines in Rural Districts," "Extra High-voltage Underground Cables and their Protection," "Empire Wireless Communications." Only Corporate Members of the Institution who were under 35 years of age on January 1st, 1931, are eligible for this award.

THE INSTITUTE OF TRANSPORT.—An Italian Tour and Congress of the Institute of Transport will take place from Saturday, May 30th, to Sunday, June 14th next. The programme will be approximately as follows:—Leaving London on Saturday, the party will arrive at Como on Sunday, leaving there on Monday and travelling by motor coaches *vid* the Auto Strada to Milan. At Milan a discussion will take place on a paper submitted by Signor Marco Semenza. Inspections will be made of the new railway station, the North Milan Railway Electrification, and the works of the Milan tramways. On Tuesday the party will proceed to Venice, where sightseeing will be resumed. From Venice the next place of visit will be Florence, where the party will remain until Saturday mid-day, June 6th. The next three days will be spent in Rome, and on Monday a discussion will take place on a paper to be submitted, while places of transport interest will be visited. On Wednesday evening, June 10th, a move will be made to Genoa, where a visit will be paid to the Port of Genoa. On Friday the party will arrive in Turin, and on Saturday a morning visit will be made to inspect the Fiat Works. The invitations for this visit are limited to 150 persons. At 6.40 p.m. the party will entrain and proceed to London, arriving at 5.15 p.m. Sunday, June 14th next.

ROYAL SOCIETY OF ARTS.—Under the will of the late Thomas L. Gray, the Royal Society of Arts has been appointed residuary legatee of his estate for the purpose of founding a memorial to his father, the late Thomas Gray, C.B., who was for many years Assistant Secretary to the Board of Trade (Marine Department). The objects of the Trust are "The Advancement of the Science of Navigation and the Scientific and Educational Interests of the British Mercantile Marine." The Council of the Society is now offering the following prizes:—I., Prize for an Invention. A prize of £100 to any person who may bring to its notice a valuable improvement in the science or practice of navigation proposed or invented by himself in the years 1930 and 1931. II., Prize for an Essay. A prize of £100 for an essay on the following subject:—"The Stability of Ships, with Special Reference to the Particulars which should be Supplied by Shipbuilders, and also the Value of any Mechanical Devices for Ascertaining the M.G., with which you are Acquainted." Full particulars can be obtained from the Secretary of the Society, John-street, Adelphi. Last year twenty-nine entries were submitted for the first named prize. On the unanimous recommendation of the judges, the Council has awarded the prize of £100 to Messrs. Charles A. Stevenson and David Alan Stevenson, of Edinburgh, for their invention, "The Talking Beacon." This "Talking Beacon," which is installed at Cumbrae Lighthouse, consists of an ingenious combination of fog signal and wireless transmitter, and enables a ship fitted with even the simplest form of wireless receiver to ascertain her distance from the lighthouse, up to about five miles, in thick weather. For the prize of £100 for an essay there were 151 competitors. On the unanimous recommendation of the judges the Council has awarded £70 to Mr. James A. S. Halcrow, Lerwick, Shetland Isles, and £30 to Lieut.-Commander Desmond A. Stride, R.N.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/- to 20/6
(1) Spanish	16/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	16/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 14 0	—
No. 1 Foundry	3 16 0	—
No. 3 Foundry	3 13 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 7 6	3 7 6
No. 1	3 8 0	3 8 0
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 6 0	—
„ „ Foundry	3 11 0	—
(c) Northampton—		
Foundry No. 3	3 7 6	—
Forge	3 2 6	—
(c) Derbyshire—		
No. 3 Foundry	3 11 0	—
Forge	3 6 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 1 6 (*a*); 4 3 6 (*b*); 4 8 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 5 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 15 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	8 15 0 to 9 0 0	—
Gas Tube Strip	10 17 6 to 11 0 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 10 0	10 0 0
Ship Plates, ¼in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	8 0 0	8 0 0
Sheets (Gal. Cor. 24 B.G.)	11 7 6	11 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0 to 7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 2 6 to 9 5 0	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	8 12 6 and 9 2 6	—
Intermediate Basic	7 2 6 and 7 12 6	—
Soft Basic	6 5 0	—
Hoops	10 5 0	—
Soft Wire Rods	7 15 0	—
MIDLANDS—		
Small Rolled Bars	7 2 6 to 8 0 0	—
Billets and Sheet Bars	5 5 0 to 5 15 0	—
Galv. Sheets, f.o.b. L'pool	11 0 0	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 2 6 to 9 5 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/3 to 15/6
Block Tin (cash)	121 5 0
„ (three months)	122 15 0
Copper (cash)	44 2 6
„ (three months)	44 13 9
Spanish Lead (cash)	11 13 9
„ „ (three months)	12 0 0
Spelter (cash)	11 10 6
„ (three months)	12 7 6
MANCHESTER—	
Copper, Best Selected Ingots	46 15 0
„ Electrolytic	48 0 0
„ Strong Sheets	77 0 0
„ Tubes (Basis Price), lb.	0 0 11
Brass Tubes (Basis Price), lb.	0 0 9¾
„ Condenser, lb.	0 1 0
Lead, English	14 2 6
„ Foreign	13 0 0
Spelter	12 10 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/3 per lb.	
Ferro Tungsten	2/- per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 0 0	7/-
„ „ 6 p.c. to 8 p.c.	£20 15 0	7/-
„ „ 8 p.c. to 10 p.c.	£20 10 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£32 0 0	10/-
„ „ „ 1 p.c. carbon	£35 0 0	12/-
„ „ „ 0·70 p.c. carbon	£37 0 0	14/-
„ „ „ carbon free	10d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 0 0 scale 5/- per unit	
„ „ 75 p.c.	£18 0 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170	
Ferro Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/6
„ „ Ell	15/6
„ „ Splint	15/6 to 16/6
„ „ Trebles	12/6
„ „ Doubles	11/9
„ „ Singles	10/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	17/-
„ „ Trebles	13/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/- to 13/6
Screened Navigation	16/6 to 17/6
Trebles	12/- to 13/6
Doubles	11/- to 11/6
Singles	10/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/-
Secondary Steam	12/9
Trebles	12/- to 13/-
Doubles	11/- to 11/6
Singles	10/3

ENGLAND.

	Inland.	Export.
(8) N.W. COAST—		
Steams		20/-
Household		30/- to 51/-
Coke		20/- to 20/6
NORTHUMBERLAND—		
Best Steams		13/6 to 14/-
Second Steams		12/- to 12/3
Steam Smalls		10/-
Unscreened		12/6 to 13/-
Household		27/- to 39/-
DURHAM—		
Best Gas		14/9 to 15/-
Second		13/3 to 13/6
Household		25/- to 37/-
Foundry Coke		26/- to 28/
SHEFFIELD—		
Best Hand-picked Branch	25/6 to 27/-	—
Derbyshire Best Bright House	21/- to 23/6	—
Best House Coal	21/- to 22/-	—
Screened House Coal	19/- to 20/-	—
„ „ Nuts	16/6 to 17/6	—
Yorkshire Hards	15/- to 16/6	—
Derbyshire Hards	15/- to 16/6	—
Rough Slacks	9/- to 10/-	—
Nutty Slacks	7/- to 8/-	—
Smalls	4/6 to 6/6	—
Blast-furnace Coke (Inland)	12/3 on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b. 14/- to 15/-		

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	20/- to 20/3
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 19/6
Ordinary Dry Large	17/9 to 18/-
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/6 to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	12/- to 13/6
Washed Nuts	18/- to 22/-
No. 3 Rhondda Large	19/9 to 20/3
„ „ Smalls	15/6 to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 36/6
Furnace Coke (Export)	16/6 to 17/6
Patent Fuel	20/6 to 21/-
Pitwood (ex ship)	24/- to 25/-
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	43/- to 46/-
Beans	24/9 to 28/3
Peas	19/9 to 21/-
Breaker Duff	9/6 to 10/6
Rubbly Culm	8/6 to 9/6
Steam Coals :	
Large	20/- to 21/-
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6 Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Central European Markets.

THERE are several factors in the present industrial situation that are disquieting to the French mechanical engineering trades. The steadily increasing deficit in the balance of foreign commercial exchanges is caused largely by the maintenance of the cost of living at a high level. That level cannot be reduced so long as adequate protection must be given to agriculture. While it is difficult to get down production costs in the French manufacturing industries, they are being lowered in nearly all other countries. The failure of the tariff truce proposal was a foregone conclusion, and is not unwelcomed by the French; but it has left the situation worse than it was before, because, in view of the negotiations, countries "consolidated" their tariffs, which means that they were raised in cases in which further protection was deemed necessary. Then the preliminary arrangements for the European Commercial Union fell through, as it was expected they would, and following immediately upon that failure is the reported successful issue of the negotiations carried out by the Central European Union, the recent meetings of which at Vienna seem to indicate that Germany is in a fair way towards completing her scheme for the creation of a "zollverein" amongst the Central European States. The importance of that movement is not overlooked, for if there ever is to be a European Union, Germany will have a strong hand, and meanwhile she will be privileged in neighbouring markets where the arrangements allow of exchanges in the interests of the countries concerned. At a recent meeting of the Fédération de la Mécanique the secretary, Monsieur Coville, said that during the past few years the German mechanical imports into France had amounted to 66 per cent. of the whole. In this amount reparation material was, of course, included, but apart from that German mechanical imports into this country increased from one year to another by 46 per cent. in quantity and 34 per cent. in value. Since the commercial convention with Germany in 1927 the imports have increased sevenfold. The British mechanical imports into France represented only 8 per cent. of the whole, while the United States contributed 5·4 per cent. Germany has, therefore, become the dominant factor in foreign trade and is laying her hands on the markets in Central Europe. The only hope for the French is to make use of their financial resources to secure trade, and this they are doing in the case of Rumania, where, it is stated, a part of the loan being made to that country will be used for railway construction, the material for which will be supplied partly by France.

Railway Accident.

The cause of the accident to the Sud-Express last week, when passing through the Etampes Station on its way to Hendaye, cannot be determined with any certainty, and while it is supposed that the dining car and the van left the rails because the points were opened prematurely, there is nothing to prove that this actually happened. On the other hand, it is declared by passengers that there seemed to be something abnormal in the running of the dining car for some time before reaching Etampes. The train was entering the station at the usual speed of 50 miles an hour when the dining car left the rails and, after running on the sleepers some distance, swung round with the van against a local train which was standing on the up line. Before the locomotive could be stopped the second coach became derailed and the first one turned over. The dining car was full at that moment. It was completely wrecked, and five passengers, including an Englishman, and two servants, were killed, while about twenty were injured, some of them seriously. The state of the permanent way after the disaster left nothing to show how the accident happened.

The Coal Trade.

The coalowners in the Nord and the Pas de Calais have this week posted notices of a reduction of 10 per cent. in the premium paid to meet the cost of living. This bonus represents 8 per cent. of the total amount of the miners' wages, and it will be applied one half this week and one half on May 1st. At present the most received by a man working at the face is 43·71f. a day, or about 7s. The owners have taken this action because all attempts at conciliation have failed, the men's union insisting that the coal industry shall be protected from imported coal so that owners may dispose of their stocks and continue to pay the present wages. The colliery companies themselves supported this claim for privileges which the Government refused, previous experience having shown that any attempt to raise artificially the price of coal was contrary to the interests of the nation. One of the strongest protests came from the Association des Grands Ports Français. In a long list of objections the Association pointed out that the French economic policy is based upon cheap raw material, which constitutes two-thirds of the imports, and that while the price of such material should be determined by competition, the interests of French coalowners are not alone at stake, for about 40 per cent. of the coal brought into the country is carried in French ships. Any measure which aims at compelling consumers to buy French coal at higher prices might give work to miners, but would deprive French seamen of a living and do considerable harm to the French shipping industry. Failing to get satisfaction, the miners still hold out their threat of a strike.

The Steel Trade.

Prices of iron and steel have undergone so little change of late that there is a general impression that they are stabilised at the lowest possible level, where profits have almost vanished. Foreign inquiries have, however made the outlook slightly more hopeful. It is believed that there can be no more weakening of prices, and in Belgium and Germany steel makers hope to carry on at a profit following reductions in wages. At the last meeting of the International Rail Union, Poland applied for admission, which was unexpected, because that country has always put forward claims that could not be accepted. The application had to be refused on the ground that the Polish steel makers claimed too large a quota.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

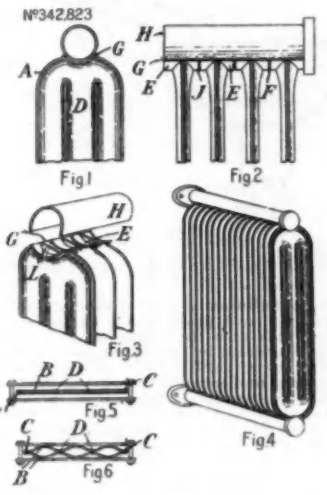
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TRANSFORMERS AND CONVERTERS.

342,823. November 27th, 1929.—HEAT RADIATORS MORE PARTICULARLY ADAPTED FOR USE WITH TRANSFORMERS, *Associated Electrical Industries, Ltd., of Bush House, Aldwych, Westminster.*

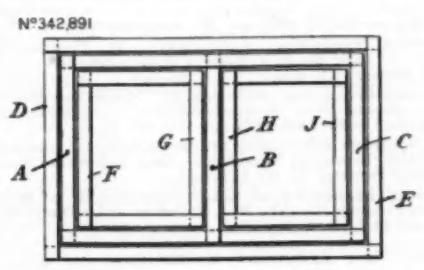
The object of this invention is the construction of a transformer cooler that may be formed of inflated riser sections welded together and to two connecting members attached to their ends. The riser sections A are formed from pairs of plates B, shown in the drawing as having a general rectangular shape, but which may be rounded towards the ends. A pair of plates of relatively thin material are welded together at their edges—as shown at C—and spot or line welded along a portion of their intermediate surfaces—as shown at D. These members are welded together while the plates are flat—as shown in Fig. 5—and after the welding process is completed, are inflated by means of compressed air to their final configuration—as shown in cross section in Fig. 6. At the ends of each section a flange E is pressed or



formed—as shown in Figs. 2 and 3—and trimmed to have a substantially rectangular configuration. Two opposite sides or edges F of the rectangle are adapted to engage corresponding flanged portions of adjacent riser members, which are so arranged that the remaining two sides of the rectangular flanges form straight edges G adapted to unite with the lower edges of a substantially cylindrical cap or closing member H to complete the construction of the header. The flanges E are so pressed or formed on the ends of the riser member as to leave a port L for the passage of fluid into or out of the riser member from the header member. When these riser sections are placed side by side in the manner shown in Figs. 2 and 3, the seams along the edges J may be welded together, thus attaching the flange of one section to the flange of the adjacent section. The flanged portions of the riser sections, thus attached, form a continuous structure comprising one portion of the header member, and are in the form of a trough having the configuration of a portion of a cylindrical surface.—*February 12th*, 1931.

342,891. January 30th, 1930.—ELECTRIC TRANSFORMERS, Ferranti, Ltd., of Hollinwood, Lancaster, and Graham Leigh Porter, of the same address.

In constructing electrical transformers difficulty is experienced in interleaving the laminations at the joints of the iron circuit when the area, and in particular the depth of the overlap exceeds certain dimensions. The object of the invention is to provide systems of subdividing the magnetic cores of three-phase electric transformers, wherein the interleaving of the laminations is simplified, either without any accompanying

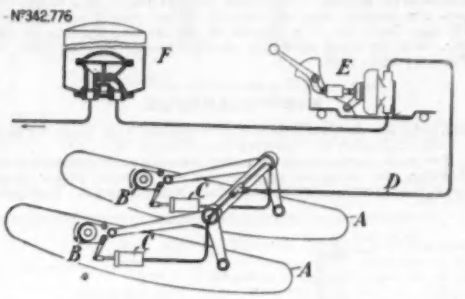


increase in the flux density in the core or with a predetermined maximum increase in flux density. A core element is provided, having three limbs A B C, with which are associated three further core elements having two limbs D E F G and H J respectively, the arrangement being such that, regarded as a whole, the limbs are divided into three portions D A F, G B H, and J C E respectively, each portion having an equal cross-sectional area, and one of the portions being linked magnetically with both of the other two limbs, the remaining portions of the limb, however, being linked magnetically with only one portion of each of the other two limbs respectively.—*February 12th*, 1931.

AERONAUTICS.

342,776. November 8th, 1929.—BRAKE APPARATUS FOR AIRCRAFT, *The Westinghouse Brake and Signal Company, Ltd.*, 82, *York-road, King's Cross, N.* 1.

The aeroplane is carried on two endless tracks of rubber and fabric A A. Each of these tracks is geared with a brake drum B B. These drums have bands which are operated by the cylinders C C. The suction for working the cylinders is provided by the pipe connection D, through the manual control valve E

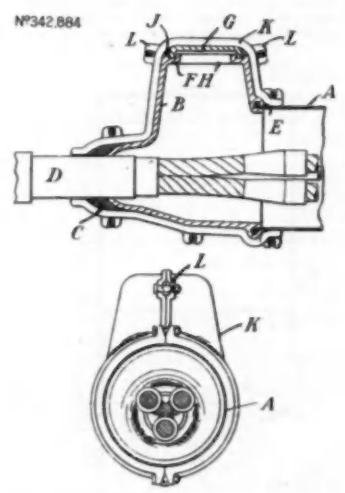


and the reservoir F, from a pipe leading to the engine induction. It is claimed that the arrangement greatly reduces the length of run necessary on landing.—*February 9th*, 1931.

TRANSMISSION OF POWER.

342,884. January 24th, 1930.—MEANS FOR ENCLOSING JOINTS IN ELECTRIC CABLES, W. T. Henley's Telegraph Works Company, Ltd., of 11, Holborn-viaduct, London, E.C. 1, and Ernest Moor, of "Medway," Sole-street, Cobham, Kent.

This invention has particular reference to joint boxes made of two or more parts, of which one or more is of relatively weak metal, such as lead or a lead alloy. Such boxes may consist of a central body formed of a brass tube and two end portions formed of lead castings, each making a joint with an end of the tube and also with the lead sheath of the cable. Boxes constructed in this manner have the advantage of being stronger mechanically than those composed entirely of lead, while at the same time the lead ends permit the ends of the body portion to be joined in a relatively easy manner to the lead sheaths of the cables to be jointed. Composite boxes of the kind indicated may not, however, be suited for certain conditions, such as when they are required to be capable of withstanding considerable internal pressure. In accordance with the invention, this disadvantage is removed. The joint box consists of a brass or copper body portion and two end portions. The body portion

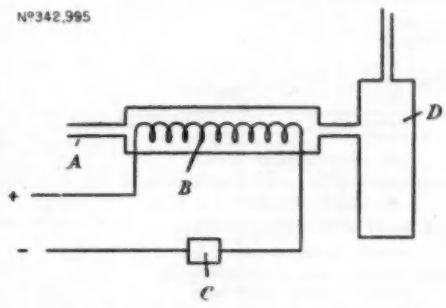


is tubular in form and is indicated at A, and connected is at its ends to the end portions B, one only of which is shown. Each end portion consists of a casting of lead jointed by means of a wiped joint C to the lead sheath D of a cable, and is also joined to the end of the body portion A by a wiped joint E. Each end portion is formed with a flange F and a cover G for a filling opening H. The cover is secured in position by a wiped joint J. In order to enable the lead end portions to resist internal pressure, they are each enclosed by a casing K of cast iron or of other suitable metal, which is stronger than the lead or lead alloy, of which the end portions are made. The casing K is made in two parts, which are placed around the end portions so as to enclose them. The enclosure so formed is split on a plane containing the axis of the cable and fits comparatively closely around its particular end portion of the joint box. The two parts of the casing are provided with slotted ears or lugs L and are clamped together by bolts or studs so that they are held in sufficiently close engagement with the outer walls of the end portions. The casing K may be lined with a material, such as pitch.—*February 12th*, 1931.

MEASURING AND TESTING INSTRUMENTS.

342,995. August 2nd, 1930.—GAS ANALYSIS APPARATUS, Aktietolaget Carba, 2, Norrmalmstorg, Stockholm, Sweden.

This invention aims at a simple means for the determination



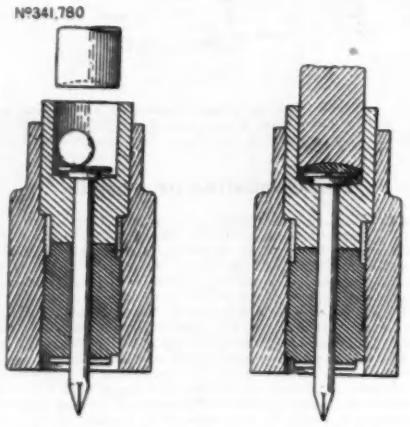
of the carbon monoxide content of flue gases. The gases are introduced at A and are analysed for their carbon dioxide content in the apparatus D. In the passage to the analyser there is an

electrical heating element B. This element is occasionally raised to such a temperature, through the intervention of the clock-work switch C, that any CO in the gases is oxidised to CO_2. Then the additional proportion of CO_2 recorded by the analyser indicates the amount of CO in the original gases. It is suggested that the heating may be effected in two stages, one at, say, 250 deg. Cent. for the oxidation of the CO, and another at 700 deg. Cent. for the combustion of other products in the gases.—*February 12th*, 1931.

MISCELLANEOUS.

341,780. March 21st, 1930.—Nails Capped with Soft Metal, *G. G. Barker*, 59, *Chancery-lane, London, W.C.* 2.

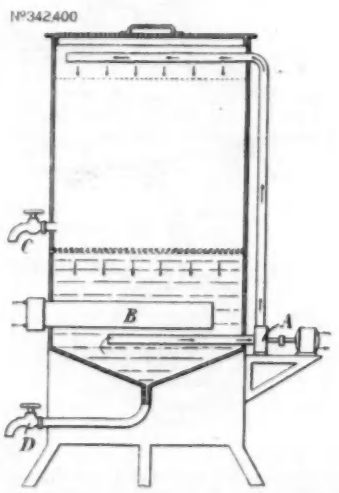
For such purposes as securing galvanised corrugated iron sheeting, the inventors propose the use of nails having their heads coated with lead to make them weather-proof. The nails



are made with a shouldered head, as shown in the drawing, and are dropped into a die. A piece of buckshot is then dropped in and a punch used to force the lead over, and round, the head of the nail.—*January 22nd*, 1931.

342,400. November 11th, 1929.—Cleaning Oils, J. F. Stallard, Ecuador, Ickenham-close, Ruislip, Middlesex.

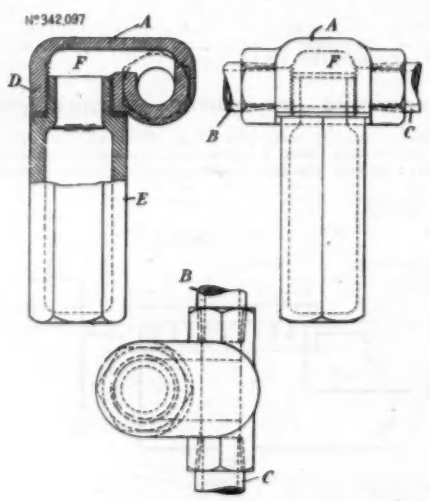
Dirty lubricating oil is cleaned by being washed with a dissolved mixture such as caustic soda, sodium silicate and talc powder kept at a temperature of about 80 deg. Fah. The solu-



tion is put in the bottom of a tank and the oil is floated on the top. The solution is continuously drawn from the bottom of the tank and sprayed over the top of the oil by the pump A, while it is warmed by the electric heater B. The cleaned oil is drawn off at C and the sludge at D.—*February 5th*, 1931.

342,097. January 3rd, 1930.—Means for Preventing the Freezing of Condensed Moisture in Compressed Air Systems, The Electro-Mechanical Brake Company, Ltd., of Eagle Works, West Bromwich, Stafford, and Stanley Smith, of the same address.

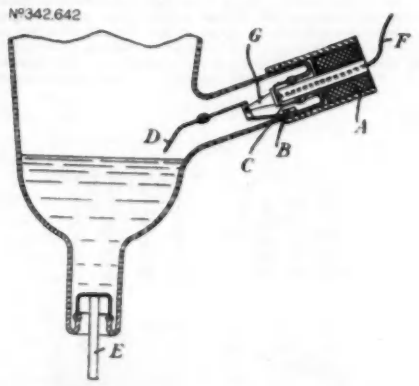
This invention relates particularly to a method of preventing



the freezing of condensed moisture in compressed air systems used in connection with the brakes of tramway vehicles and other rolling stock, though it is applicable to other kindred systems. In any convenient part of the pipe system of a compressed air installation, such as the brake system of a tramway vehicle, a fitting A in the form of a coupling is inserted, and serves to interconnect the adjacent ends of a pair of pipes B C, which are in alignment with each other. At an intermediate part of the coupling a hollow lateral projection or branch D is formed, and the underside of this projection is adapted to receive the screw-threaded upper end of a metal bottle E containing alcohol or methylated spirit, the bottle being, if necessary, suitably shaped to facilitate the rotational movement necessary for its insertion. The internal passage F in the branch D, leading from the bottle to the pipes, is situated above the lower parts of the pipes, so that moisture condensed in the pipes cannot drain into the bottle. The spirit is vaporised by and mixes with the current of air flowing along the pipes. By this simple device it is said to be possible to obviate in a convenient and reliable manner the disadvantages experienced with the ordinary anti-freezing devices used in compressed air systems.—*January 29th*, 1931.

342,642. July 8th, 1930.—Arc Ignition Device for Metal Vapour Rectifiers, Gleichrichter-Gesellschaft m.b.H., of Elizabeth-Ufer 44, Berlin, S.O. 36, Germany.

The method of igniting a mercury vapour rectifier in accordance with this invention will readily be understood from the accompanying drawing. When the electromagnet A is excited, the lever B is attracted by the core and moves up against the cap C. The end D thus dips into the mercury and closes a circuit for the current through the leads E and F. After demagneti-



sation the ignition electrode lever drops back into its position of rest, and the break spark serving for the ignition occurs. The current path from the bearing support G to the lever B D can be constituted by the bearing itself, as the current to be dealt with is very small. The whole apparatus is in a high vacuum, so that oxidisation of the parts of the bearing which might affect the passage of the current, cannot occur. In some cases a connection independent of the bearing can be obtained by the introduction of a spring or flexible conductor.—*February 5th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institute of Fuel: East Midlands Section.—Technical College, Derby. "The Power Consumption of Boiler-house Auxiliaries," by Mr. P. H. N. Ulander. 7 p.m.

Institution of Civil Engineers, Institution of Mechanical Engineers, Institution of Electrical Engineers, Institution of Automobile Engineers: Midland Graduate and Student Sections.—The Grand Hotel, Birmingham. Annual joint meeting. Discussion, "The Engineer and the World's Economic Problems." 7 p.m.

Institution of Electrical Engineers: North-Eastern Students' Section.—In the Cinema, Carliol House, Newcastle-on-Tyne. Annual general meeting. "Electricity and the Aircraft," by Mr. F. L. Turnbull. 7.15 p.m.

Institution of Naval Architects.—At the Royal Society of Arts, John-street, Adelphi, London, W.C. 1. Annual General Meeting (concluding meeting). For programme see page 292.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "Light Sensitive Work in Modern Industry," by Mr. C. E. Prince. 7.30 p.m.

Junior Institution of Engineers: North-Eastern Section.—County Hotel, Newcastle-on-Tyne. "Synthetic Resin Products," by Mr. Leonard Clegg. 7.15 p.m.

Manchester Association of Engineers.—St. John-street Chambers, Deansgate, Manchester. "Developments in Modern Foundry Practice," by Mr. E. Longden.

Royal Institution of Great Britain.—21, Albemarle-street, Piccadilly, London, W. 1. "Helium and its Properties," by Lord Rutherford. 9 p.m.

SATURDAY, MARCH 28th.

Institution of Municipal and County Engineers.—South-Eastern District meeting at Guildford, Surrey. Assemble at the Guildhall, High-street, Guildford, 11.30 a.m.

Junior Institution of Engineers: North-Eastern Section.—Visit to the Rope Works of R. Hood Haggie and Son, Ltd., Willington Quay-on-Tyne. 2.30 p.m. County Hotel, Newcastle-on-Tyne. Annual dinner. 6.45 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "Alpha-rays," by Lord Rutherford. 3 p.m.

MONDAY, MARCH 30th.

Bradford Engineering Society.—Technical College, Bradford. "Cast Iron," by Dr. H. W. Swift. 7.30 p.m.

Institution of Locomotive Engineers.—Birmingham Chamber of Commerce, New-street, Birmingham. "Improvements in Water Pick-up Gear for Locomotives," by Mr. H. Chambers. 7 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. General meeting. 5 p.m.

TUESDAY, MARCH 31st.

Institution of Civil Engineers: Birmingham and District Association; Institution of Mechanical Engineers: Midland Branch; Institution of Electrical Engineers: South Midland Centre.—In the Assembly Room of the Birmingham Chamber of Commerce, New-street, Birmingham. Annual joint meeting. "Preservation Work at St. Paul's Cathedral," by Colonel C. E. P. Sankey, which will be illustrated by numerous lantern slides. 6 p.m.

Joint Meeting.—At the Institution of Mechanical Engineers, Storey's-gate, Westminster, London, S.W. 1. Joint meeting of several Institutions, organised by the Institution of Automobile Engineers. "Injection, Ignition and Combustion in High-speed Heavy-Oil Engines," by Dr. S. J. Davies and Mr. E. Giffen. 7.45 p.m. See page 328.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "Gases in Steel (with Special Reference to Oxygen)," by Dr. Eric W. Fell. 7.30 p.m.

WEDNESDAY, APRIL 1st.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. "Short-distance Observations on Long-wave Phenomena" and "Field Strength Measurements on Daventry 5XX," by Mr. R. Naismith. 6 p.m.

TUESDAY to SATURDAY, APRIL 7th to MAY 2nd.

Ideal Home Exhibition.—Olympia, W. Daily.

THURSDAY, APRIL 9th.

Institute of Marine Engineers: Junior Section.—The Minories, London, E.C. 3. "Developments in Powdered Fuel Burning," by Mr. E. R. Chamberlain. 7 p.m.

Institute of Metals: London Local Section.—In the Rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, London, S.W. 1. Open discussion, "The Effects of Re-melting and the Use of Scrap." Annual general meeting. 7.30 p.m.

FRIDAY, APRIL 10th.

Junior Institution of Engineers.—39, Victoria-street, Westminster, London, S.W. 1. "Difficulties in Power Transmission by Belt and how to Overcome Them," by Mr. F. Russell. 7.30 p.m.

MONDAY, APRIL 13th.

Institute of Transport.—At the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Debate upon the Final Report of the Royal Commission on Transport. 5.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Howard Lectures, "The Present Position in Aeronautics," by Dr. N. A. V. Piercy. 8 p.m.

TUESDAY, APRIL 14th.

Institute of Marine Engineers.—The Minories, London, E.C. 3. "The Caprotti-Bauer-Wach Marine Installation," by Mr. F. A. Pudney. 6 p.m.

WEDNESDAY, APRIL 15th.

Newcomen Society.—Prince Henry's Room, Fleet-street, London, E.C. 4. The meeting concluding the session will take place simultaneously in London and New York. "The First Installation of House-to-house Supply in the United Kingdom," by Colonel R. E. B. Crompton; "The Pearl-street Station: The First Steam Power Station in America," by Mr. George A. Orrok; "The Civil Engineering Achievements of John B. Jervis," by Professor James K. Finch. 5.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Industrial Lighting," by Mr. D. R. Wilson. 8 p.m.

FRIDAY, APRIL 17th.

Institute of Metals: Sheffield Local Section.—In the Non-Ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. "Extrusion," by Mr. R. Genders. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. "The Transmission of Gas," by Mr. J. E. Gray; "The Building Requirements of Lifts," by Mr. T. G. Martin. 7.30 p.m.

FRIDAY and SATURDAY, APRIL 17th and 18th.

Faraday Society.—The Department of Chemistry, The University, Liverpool. General discussion on "Photochemical Processes." I.: "Molecular Spectra in Relation to Photochemical Change," Friday, 10 a.m., introductory paper by Professor R. Mecke; II.: "Photochemical Kinetics in Gaseous Systems," Friday, 2.30 p.m., introductory paper by Professor M. Bodenstein; III.: "Photochemical Change in Liquid and Solid Solutions," Saturday, 10 a.m., introductory paper by Professor Berthoud; IV.: "Photosynthesis," Saturday, 2.30 p.m., introductory paper by Professor E. C. C. Baly.

MONDAY, APRIL 20th.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Howard Lectures, "The Present Position in Aeronautics," by Dr. N. A. V. Piercy. 8 p.m.

MONDAY, APRIL 27th.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Howard Lectures, "The Present Position in Aeronautics," by Dr. N. A. V. Piercy. 8 p.m.

WEDNESDAY, MAY 6th.

Institute of Metals.—In the Hall of the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Annual May Lecture, "Progress of Power Production," by Mr. W. B. Woodhouse. 8 p.m.

SATURDAY to SUNDAY, MAY 30th to JUNE 14th.

Institute of Transport.—Italian Tour and Congress. For provisional programme see page 359.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Clarke, Chapman and Co., Ltd., Victoria Works, Gateshead-on-Tyne, ask us to say that they have received new telephone numbers as follows:—Automatic, Gateshead 72271 (six lines).

British Insulated Cables, Ltd., Prescot, Lancs., has taken out a licence under the Pirelli Patents for the manufacture of oil-filled cables. Plant is now in operation and the company is in a position to offer oil-filled cables for voltages up to and including 132 kV.

A. T. Wall and Co., consulting naval architects, announce the removal of their principal offices from Liverpool to London, at Asia House, 32, Lime-street, E.C. 3, to which all future communications should be sent. A Liverpool office will be retained at Cunard Building (first floor). Telephone, Bank 8527.